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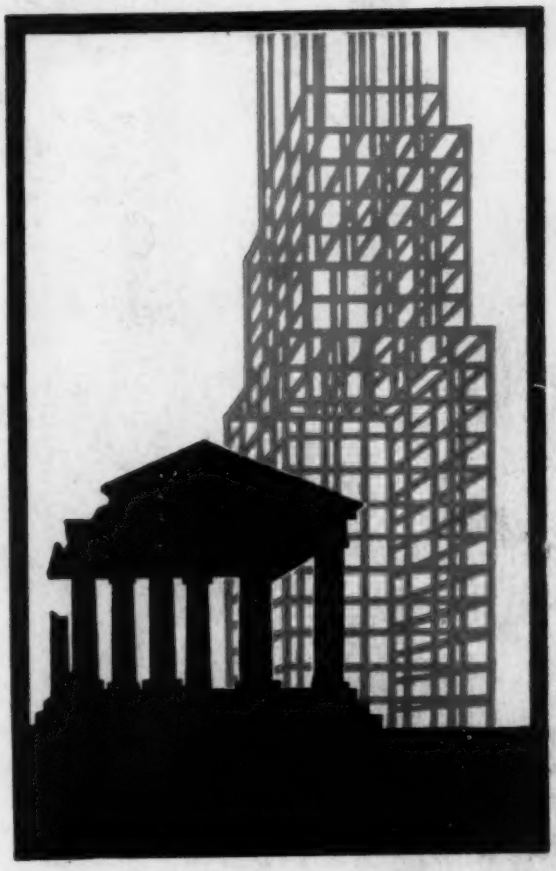
THE ARCHITECTURAL RECORD



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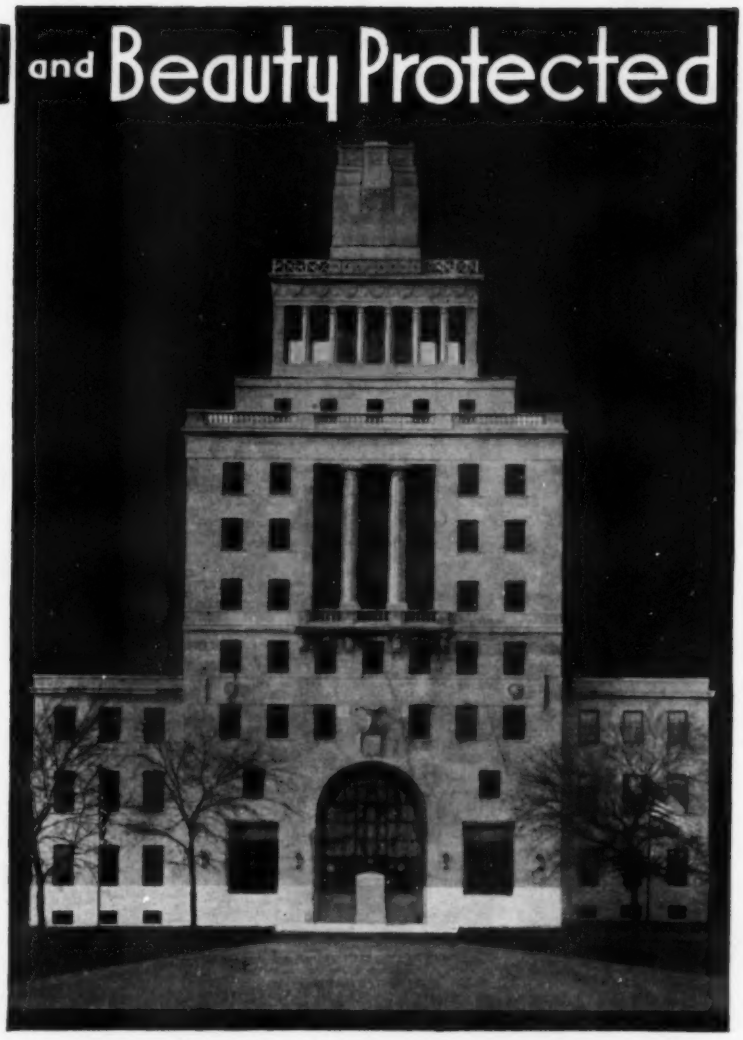
Beauty Created and Beauty Protected



Memorial Building and City Hall, Cedar Rapids, Iowa. Henry Hornbostel, Pittsburgh, Pa., architect, and W. J. Brown and Harry Hunter, Cedar Rapids, associate architects; O. F. Paulson Construction Co., Cedar Rapids, general contractor. Atlas White used for pointing, setting and backing limestone.

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J. A. OAKLEY, *Business Manager* T. A. TREDWELL, *Advertising Manager*

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A PREVIEW OF THE AUGUST ISSUE

The University Bridge at Philadelphia

As a bridge designer the architect invades what has been almost exclusively the province of the structural engineer, a field that is primarily utilitarian and with requirements that are entirely different from those of buildings. In this bridge the designer, Paul P. Cret, architect, gives his interpretation of bridge design as an architectural problem.

•

A Compact Loft Building

This building by Victor Mayper, architect, may be taken as the typical solution of the loft building. It is subdivided with a minimum waste of cargo space, and utilities occupy a minimum of floor space.

•

Notes on Drafting and Design

Constantly new ideas in design and time saving methods of producing drawings are being developed. In this issue we are illustrating various "kinks" in the design of banks which certain bank design specialists discovered by years of experimentation. We also include information on the design of doors in domestic and public buildings, and a discussion of ways to place windows so as to attain the maximum of light.

•

How Small a House?

The minimal house—the dwelling unit which will satisfy on a minimum of floor space the maximum requirements of a modern household—was the chief topic of discussion at the Frankfort Congress of Modern Architecture. Among the solutions submitted was this scheme by Le Corbusier and P. Jeanneret of Paris, outstanding because of its efficiency in combining the functions of rooms so that they serve one purpose by day and another by night. It offers a pertinent application to the planning of American apartments.

Week-End Houses and Sports Cottages

The increasing popularity of the summer camp, the week-end house and the sports cottage means more than a sentimental "back to nature" fad. They enable the city dweller to preserve the direct contact with nature that is a necessary condition for a sound society. This study of the vacation house, by Mr. K. Lonberg-Holm, presents the most recent data on the design and construction of the shelter.

•

In addition to a portfolio featuring views and layouts of various architectural offices, there will be published photographs and descriptions of new projects and buildings. Among these are the First Baptist Church of Asheville, N. C., by Douglas D. Ellington, architect, and a country house at Johnstown, Pa., by Frank Forster, architect.

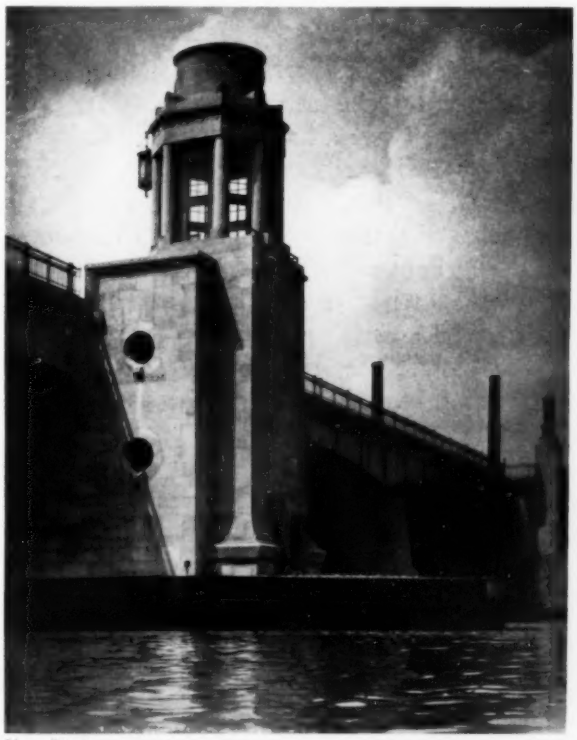
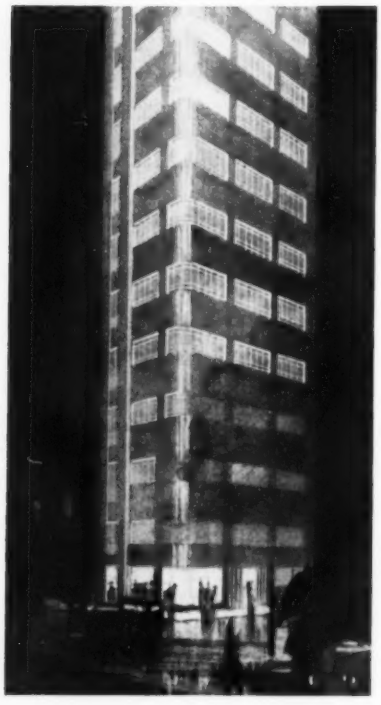


Photo. Rittase

THE UNIVERSITY BRIDGE AT PHILADELPHIA

PAUL P. CRET, ARCHITECT

THE ARCHITECTURAL RECORD



DETAIL FROM PRELIMINARY SKETCH
APARTMENT IN CHICAGO
BOWMAN BROS., ARCHITECTS

FEATURES OF THIS ISSUE

Of technical interest to the architect and which may serve well for reference use on the drafting table, the editors wish also to call attention to these features in this issue:

Notes on Drafting and Design, which include a comprehensive procedure for the design of tubular steel flag poles;

Details of Current Architecture;

The Problem of Making Brick Walls Watertight, prepared by Mr. Stanley Newman, a specialist on this subject, analyzing the causes of leaks and offering recommendations which affect specifications and construction methods;

Theatre Acoustics, Ventilating and Lighting, which brings forth the latest data on these topics and supplements a Technical News study of the theatre appearing in the May issue.

A PIONEER: THE ALL-METAL APARTMENT HOUSE

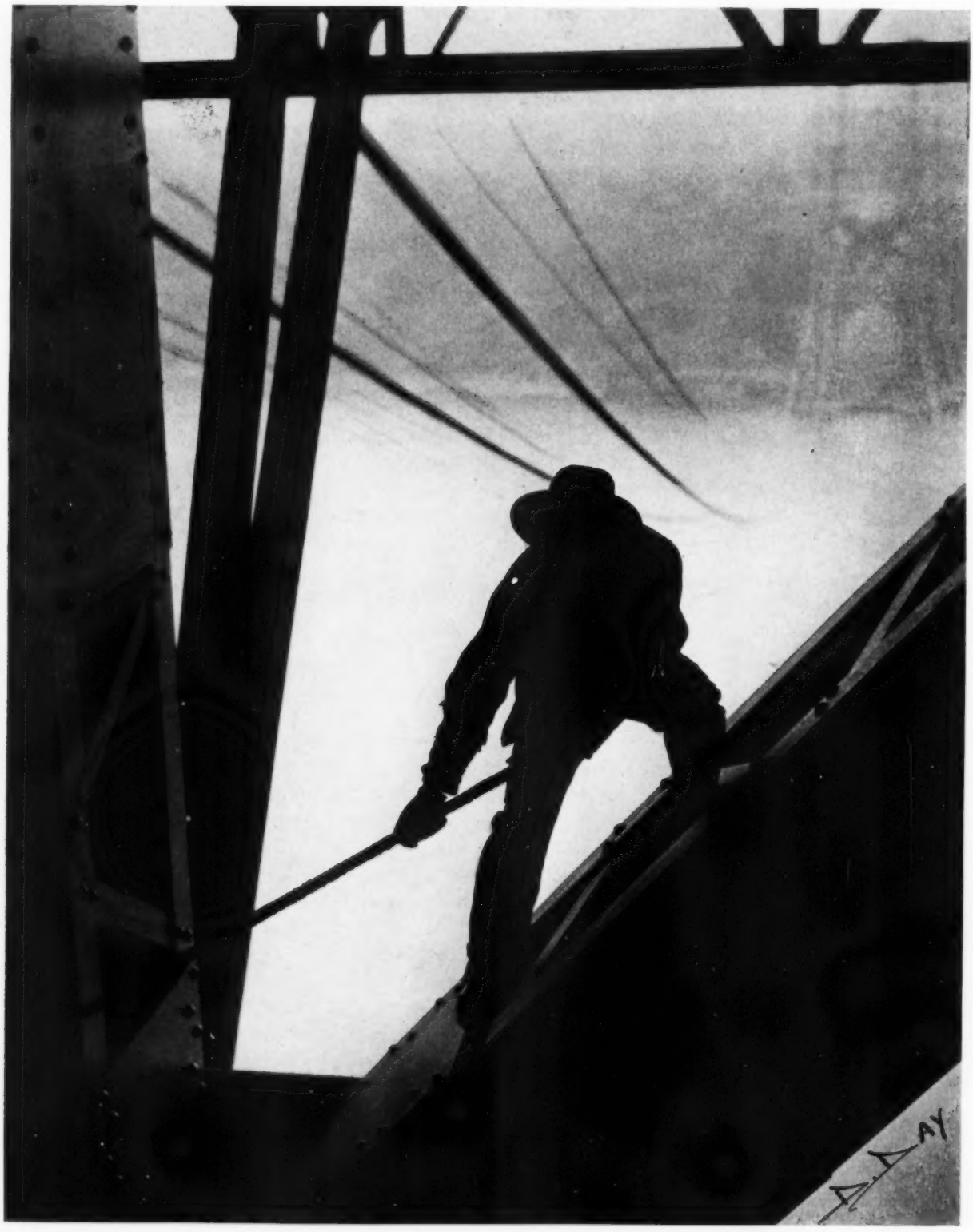
In the American skyscrapers, brought into existence by the strength of steel, we have seen of late an increasing use of aluminum and stainless steel for the spandrels. The new Chrysler, Empire State, and Hollander Buildings, New York City, have metal spandrels; backed with brick, the metal is decorative rather than functional and the advantages of a thin wall have been offset. Nevertheless, the metal spandrels have been indicative of the trend toward a new construction—they are the transition.

Now, with a rapid stride forward, we come upon a building which will have for the first time in America a construction entirely of metal and glass—an apartment house designed by Bowman Brothers, architects, and shortly to be erected in Chicago. Ground will be broken for the building in October, according to a letter just received from the architects.

The project is presented as the news feature of this issue with a full description of the construction and a complete analysis of its costs and economic importance.

In its economic potentialities, with a cutting down of erection costs, head loss, excess weight and wasted space, and with an increase of rentable floor space, the metal construction promises much for the investor. On a comparatively small ground plot such as this particular apartment house possesses, the increase of rentable floor area may be so proportionally high that the increased return on the equity will induce a hesitating builder to build. Here, it is felt, by pointing out to clients the possibilities of increased income from such construction in metal there is an opportunity for the architect to stimulate his own business.

As a pioneer of the new type the building deserves the attention of the historians. The use of metal construction means the evolution of new designs: obviously the forms that gave character to brick and masonry would be illogical and absurd if translated into metal. New building forms, expressive of the new medium, are inevitable.



STRINGING THE CABLES ON THE NEW HUDSON RIVER BRIDGE

THE ARCHITECTURAL RECORD

AN ILLUSTRATED MONTHLY MAGAZINE OF
ARCHITECTURE & THE ALLIED
ARTS & CRAFTS

VOLUME 68 JULY • 1930 NUMBER 1

THE FIRST ALL-METAL APARTMENT HOUSE

LAKE FRONT BUILDING, CHICAGO
BOWMAN BROTHERS, INC., ARCHITECTS

INCREASED RENTABLE AREA—INCREASED PROFIT TO OWNER

A PROBLEM OF RENTABLE AREA

To build an apartment house which will have the maximum usable floor area and number of floors compatible with livability, economy and the building code.

•

A SOLUTION IN METAL CONSTRUCTION

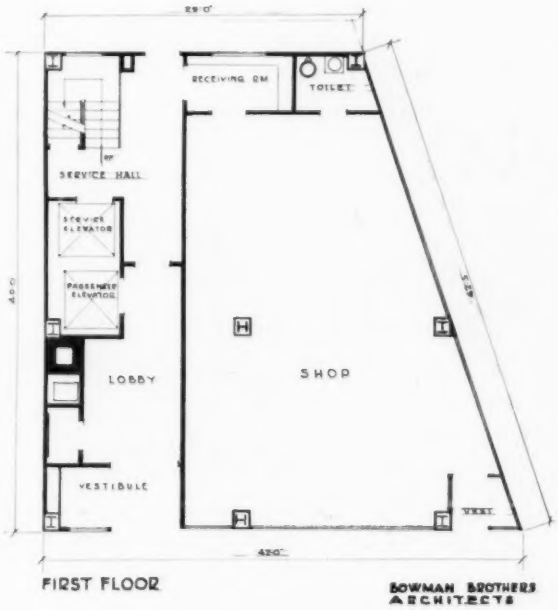
Insulated metal walls which increase the net floor area, decrease the heat loss and cost less than masonry; battledeck floors which permit the addition of another floor and still keep within the height limit of the zoning ordinance. The reduction in heat loss through insulated walls and double windows and savings in construction cost permit the inclusion of such additional features as electric heat and other special equipment.

•

METAL WALLS

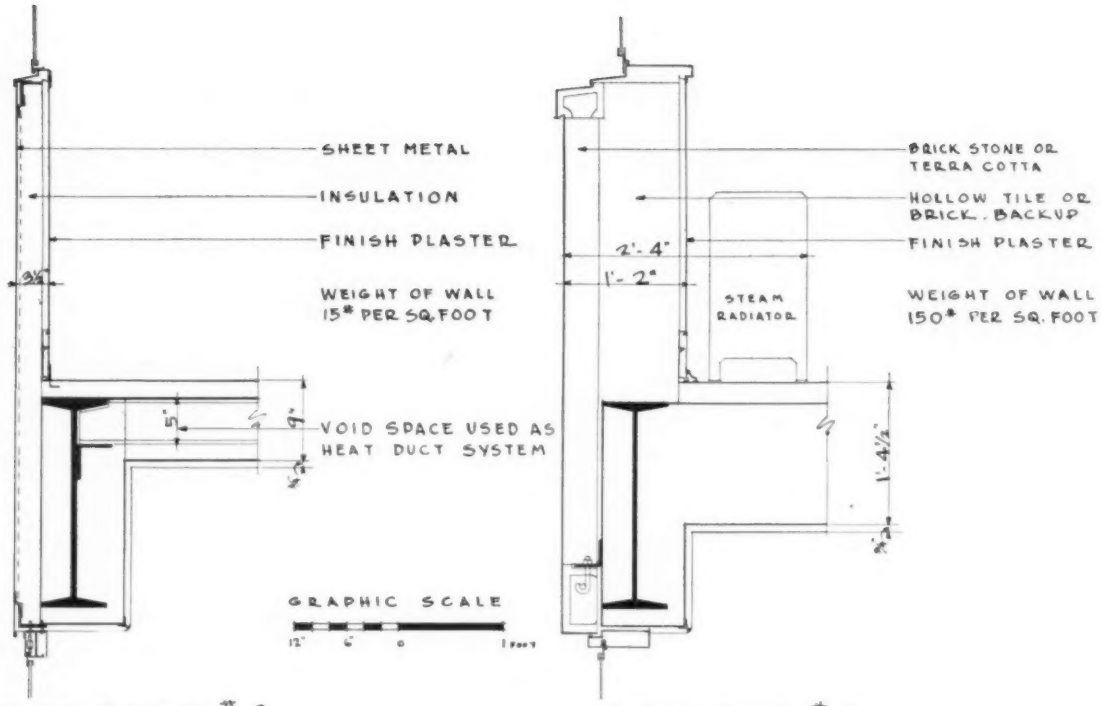
In order to increase the usable floor area, decrease the dead load of the walls, increase the heat insulation value of the ex-

TYPICAL FLOOR



FIRST FLOOR

BOWMAN BROTHERS ARCHITECTS



SECTION * 2
FIREPROOF SPANDREL
WALL CONSTRUCTION
IN BOWMAN BROTHERS PRACTICE

SECTION * 1
FIREPROOF SPANDREL
WALL CONSTRUCTION
IN CURRENT PRACTICE

METAL WALL INCREASES NET FLOOR AREA

terior wall, eliminate trouble from leaking walls and at the same time reduce the first cost of the building, the wall shown in the accompanying drawings was developed.

A. SPACE SAVED

Section No. 1 shows the old type of masonry wall construction occupying 14" of space along the perimeter of the building. Section No. 2 shows the new type of metal wall construction which occupies only 3½" of the space along the perimeter of the building.

AREAS FOR LAKE FRONT BUILDING

Areas	*Masonry Walls*	*Metal Walls*
Non-Rentable Area*		
Ext. Walls.....	179 sq. ft.	44 sq. ft.
Balance.....	276 sq. ft.	276 sq. ft.
Net Rentable.....	965 sq. ft.	1100 sq. ft.
Gross.....	1420 sq. ft.	1420 sq. ft.

* Non-rentable includes elevators, stairs, public halls, chimneys, air ducts, columns, partitions and exterior brick walls.

The savings** through using metal walls is 135 square feet or 14% of the net rentable area if it were built with brick walls.

B. INCREASED INCOME

A decrease in the thickness of the exterior walls of a building means an increase in floor area. In the case of a building with a comparatively small ground area this increase will be a large percentage of the net rentable floor area, which will represent a greater return to the owner in inverse ratio to his equity. The larger the plan area the less will be the percentage of increased return on the equity.

Applying this method to an office building of same area and shape renting at $4 a square foot, the rent with the masonry walls would be $3,860 a year whereas with metal walls the rent would be $4,400, an

** Brick Wall 1'-2" x 153' = 179 sq. ft.
Metal Wall 3½" x 153' = 44 sq. ft.
Saving 135 sq. ft.

increase of $540 or 14% on the gross income for each floor. As a matter of fact the metal walls will cost less as shown later.

This increase of 14% in the income of the entire building will represent an additional net income on the equity of 56%, if the equity is assumed at one-fourth of the total cost of the project.

This is an exceptional case; in the ordinary office building the increase in net rentable floor area for a larger ground plot would not ordinarily exceed 3%. This would represent an additional net income on the equity of approximately 12%, assuming that the equity is 25% of the total project cost.

C. WALL CONSTRUCTION

An analysis was made of different types of metal walls including:

I. A wall built of sheet aluminum with aluminum framework within, waterproofed and insulated, etc.;

II. A wall built of sheet aluminum with steel framework within, waterproofed and insulated, etc.;

III. A wall built of Allegheny Metal "KA2" (not to be confused with stainless steel "Ascoloy" which is the name given to chromium steels without a nickel content).

A wall built of "Ascoloy" sheets with steel framework within, waterproofed and insulated, was discarded because of the cost of the necessary maintenance. Steel sheet was also considered instead of "Ascoloy" but was discarded because of the cost of necessary maintenance.

Other metals were also included but are not interesting because of their high cost or lack of practicability.

In each case these metal walls were designed as slabs where the live load was represented by the wind load. The thickness of the metals was varied according to respective tensile strengths and designed by the deflection formula. A large factor of safety was allowed to take care of intangible items, such as vibration and shivering under a high wind, denting, etc.

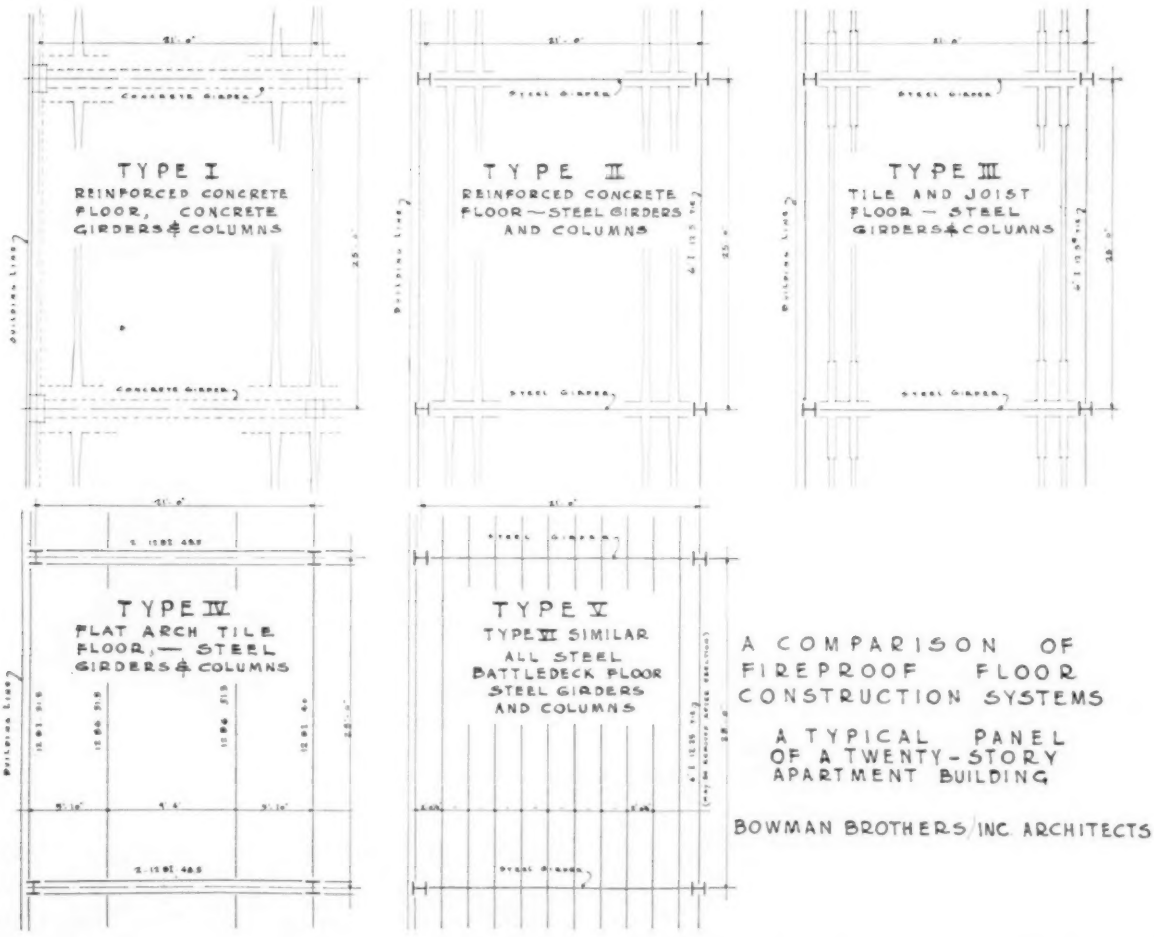
MODEL OF ALL METAL APARTMENT HOUSE

BOWMAN BROTHERS, ARCHITECTS

The method of fastening was a problem. Riveting the sheets was discarded as impractical, due to the difficulty of matching holes in sheets to holes in the framework of the wall. Welding was also discarded as being too costly and actually not necessary. The method which proved to be the most practical from the standpoint of good construction and economy and erection time was clamping the sheets to the framework with straps, all edges having been formed in the shop to permit lock-seaming.

Allegheny metal, which was selected for the wall, does not require paint or maintenance of any kind for at least thirty years. This wall will cost for metal in place approximately $1.20 a square foot, plus $.16 for insulation, plus $.17 for metal lath and plaster, or a total of approximately $1.53 a square foot of wall surface which is less than masonry wall ($2.17 a square foot) with waterproofing, furring, lath and plaster.

It must be kept in mind that the above described metal wall is equivalent to a 36"


TYPE I
REINFORCED CONCRETE FLOOR, CONCRETE GIRDERS & COLUMNS
TYPE II
REINFORCED CONCRETE FLOOR — STEEL GIRDERS AND COLUMNS
TYPE III
TILE AND JOIST FLOOR — STEEL GIRDERS & COLUMNS
TYPE IV
FLAT ARCH TILE FLOOR, — STEEL GIRDERS & COLUMNS
TYPE V
TYPE II SIMILAR
ALL STEEL BATTLEDECK FLOOR STEEL GIRDERS AND COLUMNS
A COMPARISON OF FIREPROOF FLOOR CONSTRUCTION SYSTEMS
A TYPICAL PANEL OF A TWENTY-STORY APARTMENT BUILDING
BOWMAN BROTHERS, INC. ARCHITECTS

brick wall in heat insulation value and if the cost of a 36″ brick wall (stone facing) were compared with the above metal wall a still greater difference would be apparent. Or by adding the cost of 2″ of insulation to the 12″ stone wall with brick backup, a fair comparison would be made.

The time saving effected by the use of a metal wall is considerable and must be taken into account. Furthermore, the maintenance of stone walls (tuck-pointing, cleaning, etc.) is costly, whereas the metal wall requires none.

D. INSULATION

The metal wall is to be backed with 3″ slabs of rock wool. This material should not be confused with mineral wool which will compress under vibration, or blocks composed of mineral wool held together by asphalt compounds which will disintegrate or settle under heat and jarring. Rock wool will not disintegrate or settle at any temperature between 40 degrees below zero to 1,250 degrees Fahrenheit. Its coefficient of conductivity is .27 B.t.u.* (approximately the same as cork board) and it weighs 12 pounds a cubic foot. The overall conductivity of the wall with metal face, 3″ of rock wool and interior plaster, will be approximately .09 B.t.u. an hour per square foot. This is roughly equivalent to a brick wall 36″ thick.

•

FLOOR CONSTRUCTION

An analysis was made to find the best type of floor, giving consideration to cost, space occupied, length of time required for construction, and sound insulating factors.

•

COSTS

To arrive at accurate floor construction costs, the architects, in cooperation with

* A.S.H.V.E. Guide 1930. Page 23.

engineers, designed one panel of a building in six different types of construction. The types were as follows:

•

Type I. Reinforced concrete floor, girders and columns. (10 plus 2½, 6″ joists at 36″ cts., widened to 10″ at ends. Plaster ceiling included.) The cost of this system was only $1.17 a square foot but its dead load weight of 64 lbs. required columns of excessive size and for this reason was discarded as being impractical.

•

Type II. Reinforced concrete floor, steel girders and columns. (10 plus 2½, 5″ joists at 25″ cts. widened to 9″ at ends and plaster ceiling included.) The cost of this system was $1.33 a square foot. Dead load weight was 68 lbs. a square foot. The columns for this type of floor were 14″ BH-236 lbs. at the ground floor and cost $.412 a square foot, totaling $1.74 a square foot complete.

•

Type III. Tile and joist floor, steel girders and columns. (10 plus 2, 4″ joists at 20″ cts., 10″ tile fillers widened to 8″ at ends by using 12″ tile. Plaster ceiling included.) The cost of this system was $1.39 a square foot. Its dead load weight being 79 lbs. a square foot, the columns thereby were increased in weight. No saving could be effected over *Type* II.

•

Type IV. Flat arch tile floor, steel girders and columns. (14″ flat arch tile, 2″ concrete top. Plaster ceiling included.) The cost of this system was $1.38 a square foot. Its dead load weight being 74 lbs. a square foot, the columns thereby were increased in weight. No saving could be effected over *Type* II.

•

Type V. All steel battledeck floor, steel girders and columns. (5″ I-beams 14.75 lbs. 24 x 3/16″ plates. 2″ tile fireproofing. Plaster ceiling included. Spandrel wall with brick facing, hollow tile backup, T.C. sills and head.) The cost of this system was $1.35 a square foot. Its dead load being reduced to 42½ lbs. a square foot, the columns thereby were reduced in cost to $.289 a square foot, totaling $1.64 a square foot complete.

•

Type VI. All steel battledeck floor, steel girders and columns. (5″ I-beams 12.25 lbs. 24″ x 3/16″ plates. 2″ tile fireproofing. Plaster ceiling included. Spandrel wall of metal filled with mineral wool.) This construction is the same as *Type* V except in the spandrel wall weight. Its cost per square foot for the floors was $1.32 and for the columns was $.254, totaling $1.57 a square foot complete. Saving over *Type* II was $.17 a square foot.

Note: In the above outline no finish flooring was included. As there is such a great variety of finish flooring available, a separate analysis was made, the schedule for which accompanies this article.

•

SPACE GAINED

For a 25′ span the floor thickness of battledeck steel floor system is 9″ (including finish floor) as compared with 16½″ (including finish floor) if the flat tile arch construction were used. In the Lake Front Building this means that where twenty stories are now permitted under the present zoning ordinance, twenty-one and one-half stories of the same clear ceiling height can be built within the same volume.

•

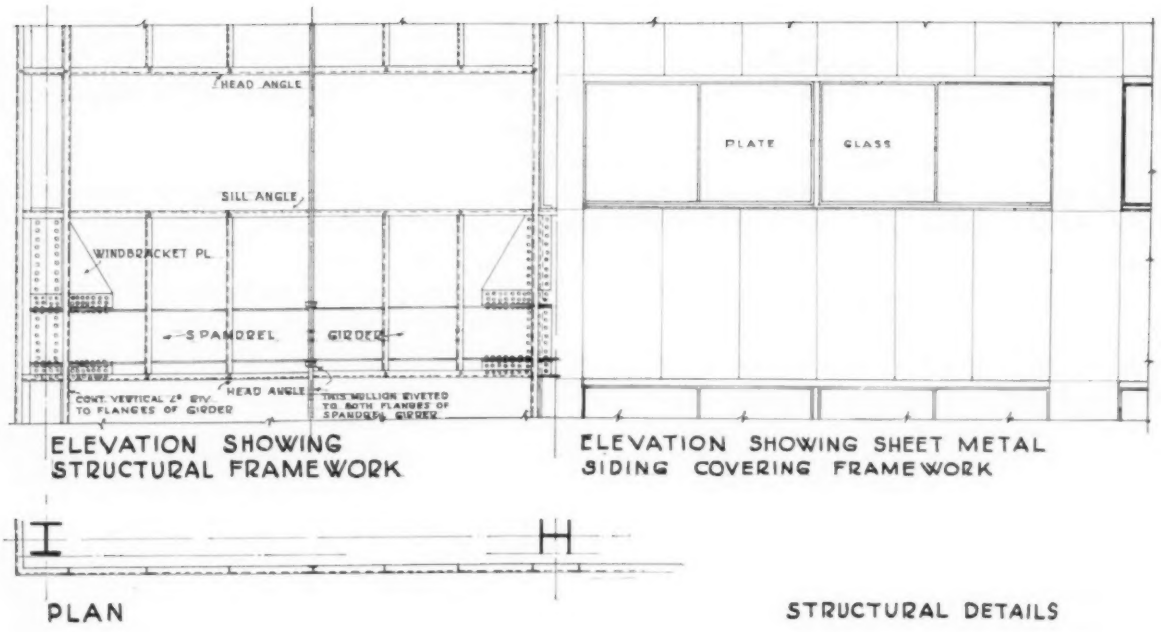
ADVANTAGES OF METAL WALL AND FLOOR CONSTRUCTION

The outstanding advantages of these two methods when combined are the increase in usable volume, decrease in cost and speeding up of erection time. The latter feature, the saving in time required for erection, is of considerable importance in some buildings.

•

CONSTRUCTION TIME SAVING

The metal building is like a large Meccano set, fabricated almost entirely in the steel mills where the work done on it can be accomplished in a much more efficient manner because of the availability of rig-



ELEVATION SHOWING STRUCTURAL FRAMEWORK

ELEVATION SHOWING SHEET METAL SIDING COVERING FRAMEWORK

PLAN

STRUCTURAL DETAILS

ging for punching, riveting, welding and other fabricating operations.

Where the battledeck floor is used, it can be built of plates and I-beams on 2′ centers in such a way that three or four widths of plates may be shop-welded to the I-beam joists which support them and delivered to the job in sections with two-thirds of the welding already done. This would effect a cost saving in the welding and a time saving in the erection.

Where a metal floor system is used consisting of I-beam joists with Holorib, Mahon, Truscon or other steel roof decking inverted and laid on the top of the joists and filled with terrazzo, a still greater saving in cost of material and welding is effected as well as a great saving in erection time.

Time savings in construction are of primary importance because during the entire time that a building is under construction capital must be at hand, ready to be paid out and yet not a cent can be taken in. A building taking a year to build using the old methods of so-called fireproof construction would take from eight to nine months to construct entirely in metal. This means that the money invested is idle for only 65% to 75% of the time that it has been idle heretofore.

SPECIAL FEATURES IN BUILDING

Electric Heating

Since the wall construction is insulated to such a high degree, the loss of heat through the wall is reduced to just one-third of the normal loss. Since the windows are double-glazed, the loss of heat through them is reduced to one-half of the normal loss.

The average heat loss through wall and window is thereby reduced to approximately 41% of the heat loss which exists in popular fireproof construction.

These drastic reductions in heat losses make the use of electric heat possible. Also consider the fact that since so much electricity is consumed by this building in operating radiators, ventilating equipment, elevators, refrigerators, ranges, dish washers, clothes driers, general lighting, etc., the public utilities can furnish power at a reduced rate.

The architects have found a means of heating the apartments in such a way that the air will not be scorched and the moisture evaporated as it is in the average steam heated apartment of today.

Due to mechanical circulation of the air across the heating elements by means of fans, the air in the room is constantly in motion which means that the difference in

temperature from floor line to ceiling line will be only two degrees resulting in a comfort heretofore impossible with any other means of direct radiation.

•

Interiors

All interiors are treated in the most modern manner without being tricky or faddish, "modern" being interpreted as the simplest way to obtain an end.

All rooms in this building are indirectly lighted, giving an even glow of perfectly shadowless light.

•

Kitchens

All kitchens will be equipped with mechanical ventilation, electric ranges, electric refrigerators and electric dish washers. The cabinet work being entirely in metal is vermin proof and cannot warp or shrink.

•

Bathrooms

The bathrooms will have large sunken tubs enclosed in plate glass; special lavatory built entirely of metal; dressing table; mechanical ventilation as well as two large windows; built-in towel cabinets, medicine cabinets, etc.

•

Lobby and Vestibule

The building lobby and vestibule will be wainscoted with marble from floor to ceiling. The floors are of terrazzo and the ceiling silver-leafed. The lighting fixtures are executed very simply in pewter.

•

Elevators

The elevators are of high speed type, the cabs being leather covered; the elevator controls are entirely automatic, but uniformed operators will be always on duty.

•

Radio Facilities

It has been claimed that radio reception in an all-metal building would be impossible. This is not true of this building, owing to the fact that one aerial is installed on the roof and one centralized radio is located in the elevator penthouse. This radio set is so designed that it can be operated by remote control from any apartment in the building in such a way that each tenant may select any station on the dial without interference from any other apartment, even though they are all receiving from different stations.

In each apartment there will be a loud speaker installed in a flush panel with one volume dial and one tuning dial only. The mechanism installed in each apartment is so designed that no amateur mechanic can remove any parts or tamper with any adjustment. Extensions may be made from the loud speaker to any other room in which a loud speaker is desired, similar to telephone extensions.

The fact that the building is constructed of metal walls assists in shielding the radio sets within its walls from interference of outside disturbances.

•

Lightning Safety

Making an object lightning-safe requires its proper "grounding." The walls being constructed of metal and connected to the ground, any electrical charge which might accumulate on its face by induction, as from a passing cloud, will be conducted immediately to the earth.

ROBERT L. DAVISON.

COST SCHEDULE OF FINISHED FLOORING FOR BATTLEDECK CONSTRUCTION

MATERIAL	SIZE	UNDER BED	ADDITIONAL FIRE-PROOFING REQUIRED	OVERALL THICKNESS	TOTAL COST PER SQ. FT.
QUARRY TILE RED	1" THICK 9"x9" SQ.	1½" CEM. GROUT	NONE	2½"	85¢
	⅜" THICK 6"x6" SQ.	"	"	2⅛"	73¢
QUARRY TILE BROWN	1" THICK 9"x9" SQ.	"	"	2½"	95¢
	⅜" THICK 6"x6" SQ.	"	"	2⅛"	85¢
ART MARBLE (BOTTICINO)	1" THICK 12"x12" SQ.	"	"	2½"	85¢
TERRAZZO	⅜" MARBLE CHIPS BRASS STRIPS 24"O.C.	½" "	"	2"	40¢
*MOULSTONE	½" THICK WEARING SURF.		2" CEMENT SLAB SIDEWALK FINISH	2½"	36¢
MASTIC (100% ELATEX)	3/16" THICK WEARING SURF.		"	2⅛"	42¢
LINOLEUM	¼" BATTLESHIP		"	2¼"	46¢
CORK	⅛" THICK		"	2⅛"	60¢
RUBBER TILE	⅛" THICK		"	2⅛"	71¢
*OAK 1 RED	⅞" THICK 12" PARQUET SQUARES		"	3"	75¢
*OAK 1 RED	⅞" THICK 2¼" STRIP FLOORING		2" CEMENT SLAB ROUGH	3½"	66¢
CARPET COMMERCIAL GRADE	ABT. ¼" THICK	½" OZITE	2" CEMENT SLAB SIDEWALK FINISH	2¾"	110¢

* A FORM OF HARDENED MASTIC

The August issue of THE ARCHITECTURAL RECORD will contain a Technical News study on qualities of various metals for exterior use.

FOREMAN STATE NATIONAL BANK BUILDING, CHICAGO

GRAHAM, ANDERSON, PROBST AND WHITE, ARCHITECTS

LOCATION

Situated at the center of Chicago's financial district on the site of the old Chamber of Commerce Building. It is immediately opposite the City Hall and County Building.

•

LAYOUT

The entrance to first floor banking room extends the entire 30-foot width of the lobby, which obtains a direct thoroughfare from La Salle Street to Clark Street through the bank building and the adjoining building. The ceiling height is 14 feet in the clear.

Commercial banking room extends almost the entire length of the building and is 167 feet long, 57 feet wide, and 36 feet high.

The Foreman State National Bank, the Foreman State Trust and Savings Bank, and the Foreman State Corporation Investment Affiliates occupy nine floors of the building, with two separate elevators which serve the bank premises exclusively. Above the banking floors are offices.

On the sixth and seventh floors are located the investment and trust departments. The directors' room, private dining room and kitchen are located on the 38th floor. The usual type of directors' room with its long table and stiff chairs has been replaced by a room where the bank officers may lounge after their luncheon.

Vault chambers occupy the entire basement. There is a capacity of 35,000 boxes, 95 coupon booths, and 11 conference rooms. A spacious ladies' lounging room is provided on this floor for those women who wish to rest or who have made an appointment to meet friends.

FOREMAN STATE NATIONAL BANK BUILDING, CHICAGO

GRAHAM, ANDERSON, PROBST AND WHITE, ARCHITECTS

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MATERIALS

Lower six stories faced with Ausable polished granite; Indiana limestone veneer upper 36 stories; walls of lobby and main banking room: Tavernelle Claire marble slabs; floors of lobby and bank: Tennessee marble; office corridors are in Botticino marble with Tennessee marble floors.

OFFICERS' DESKS

Photos. Chicago Architectural Photographing Co.

LOUNGING ROOM

FOREMAN STATE NATIONAL BANK BUILDING, CHICAGO

GRAHAM, ANDERSON, PROBST AND WHITE, ARCHITECTS

Photo. Chicago Architectural Photographing Co.

OFFICERS' SPACE

FOREMAN STATE NATIONAL BANK BUILDING, CHICAGO

GRAHAM, ANDERSON, PROBST AND WHITE, ARCHITECTS

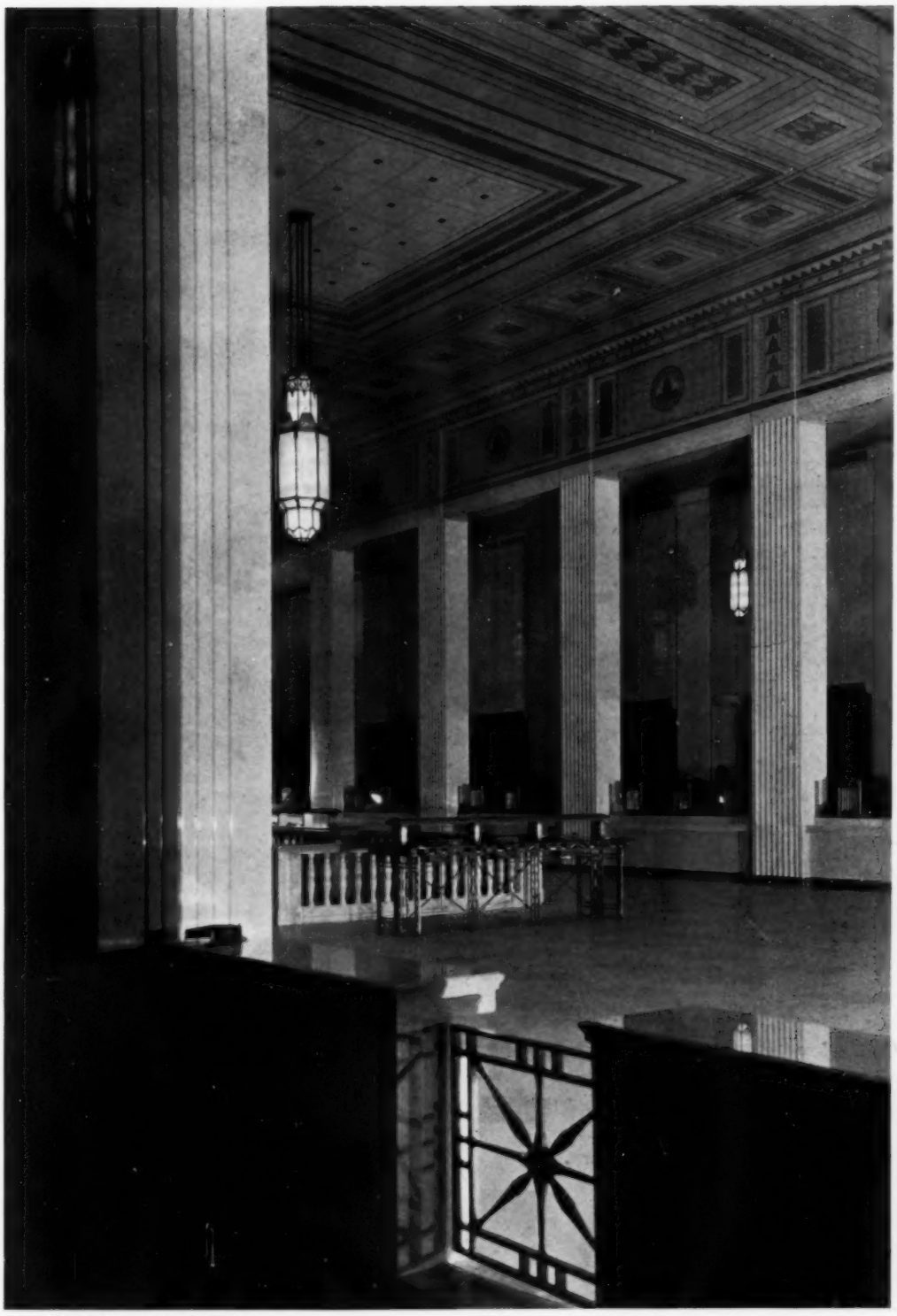
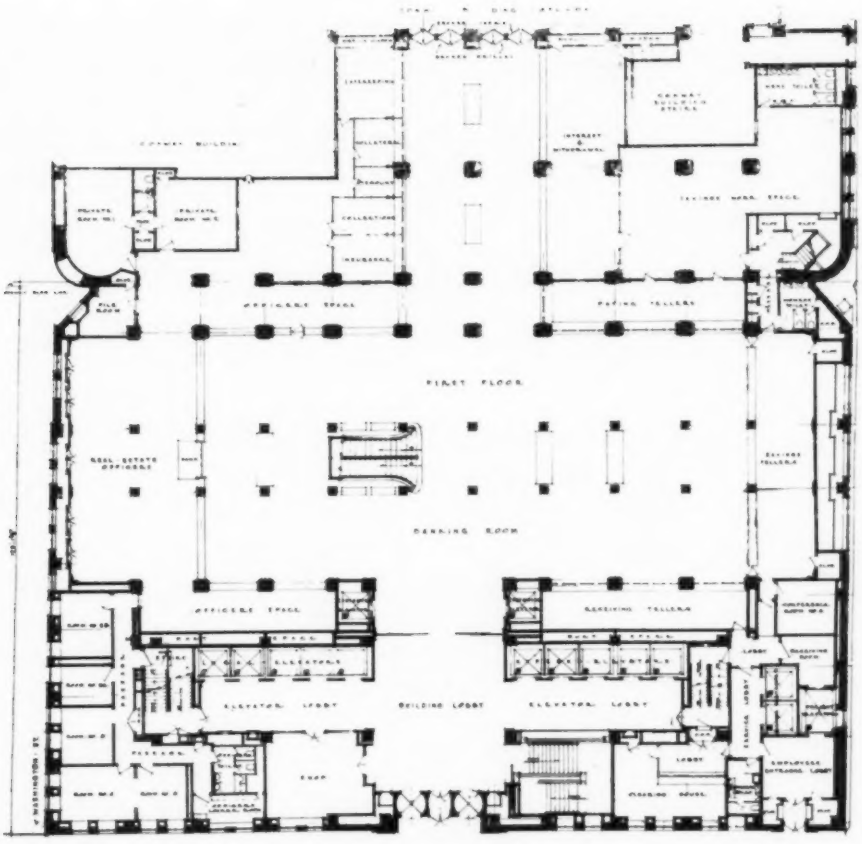


Photo. Chicago Architectural Photographing Co.

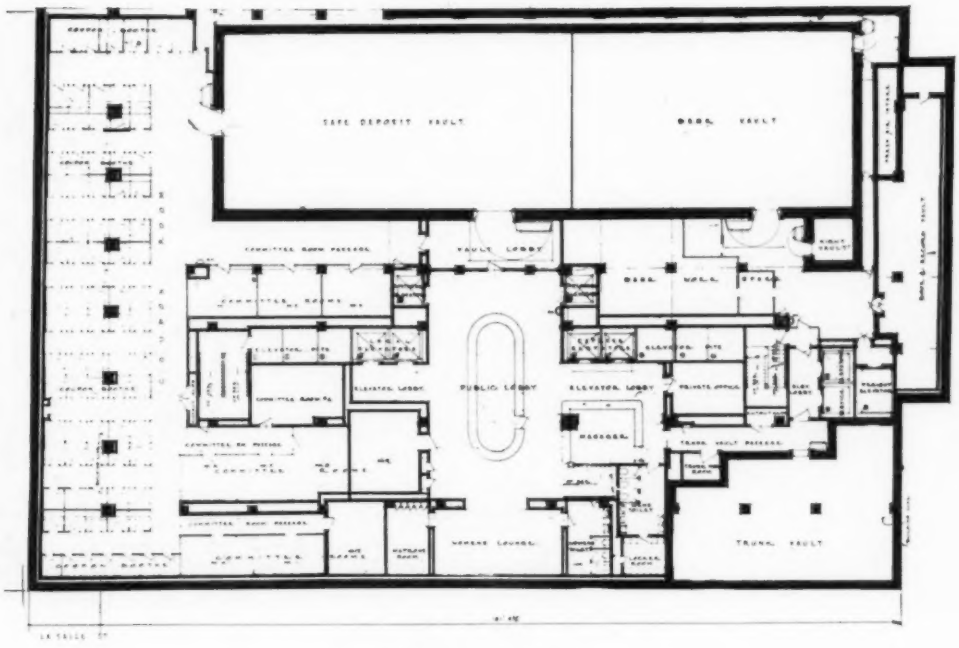
COMMERCIAL BANK ROOM

FOREMAN STATE NATIONAL BANK BUILDING, CHICAGO

GRAHAM, ANDERSON, PROBST AND WHITE, ARCHITECTS



GROUND FLOOR PLAN



BASEMENT PLAN

FOREMAN STATE NATIONAL BANK BUILDING, CHICAGO

GRAHAM, ANDERSON, PROBST AND WHITE, ARCHITECTS

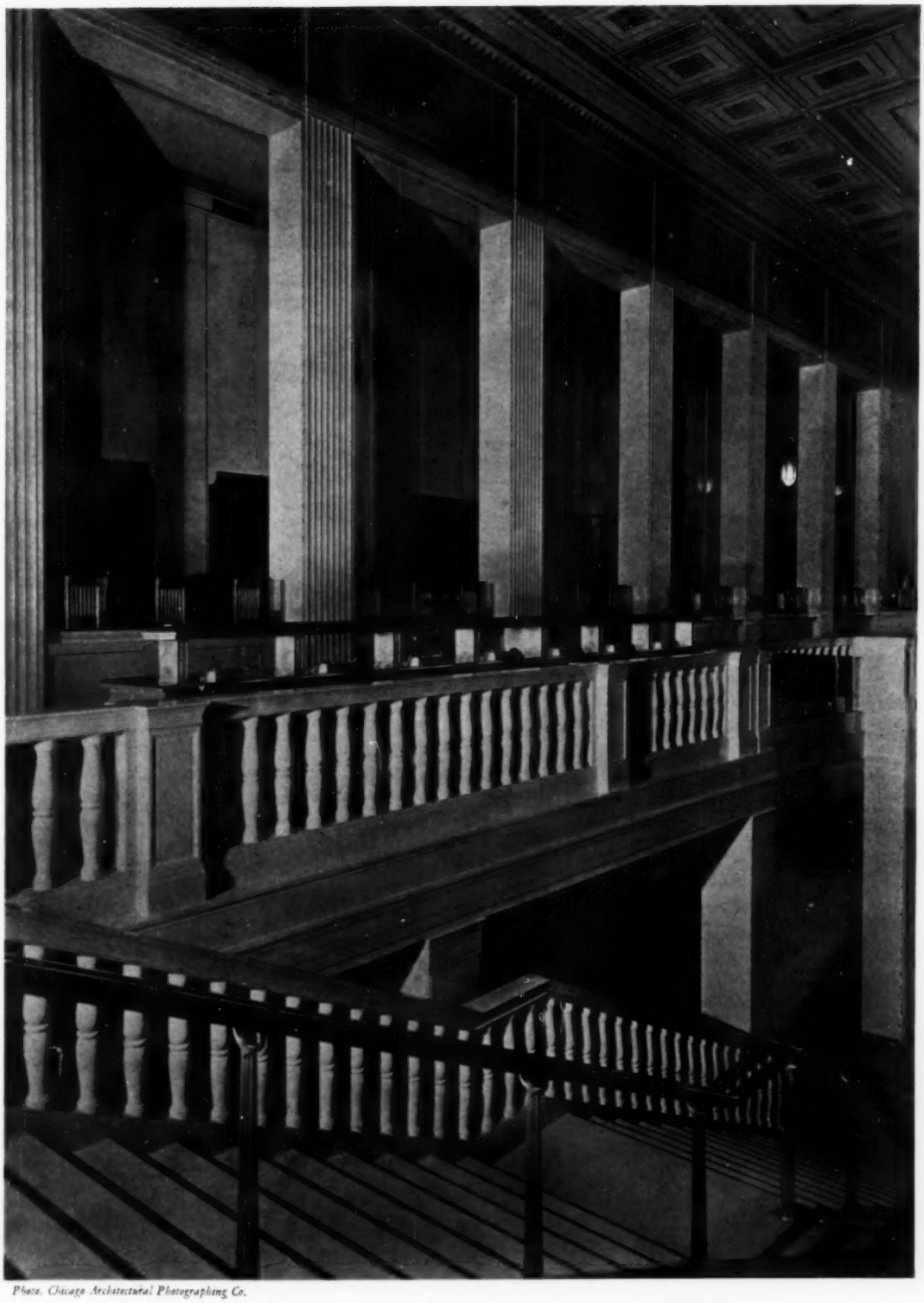
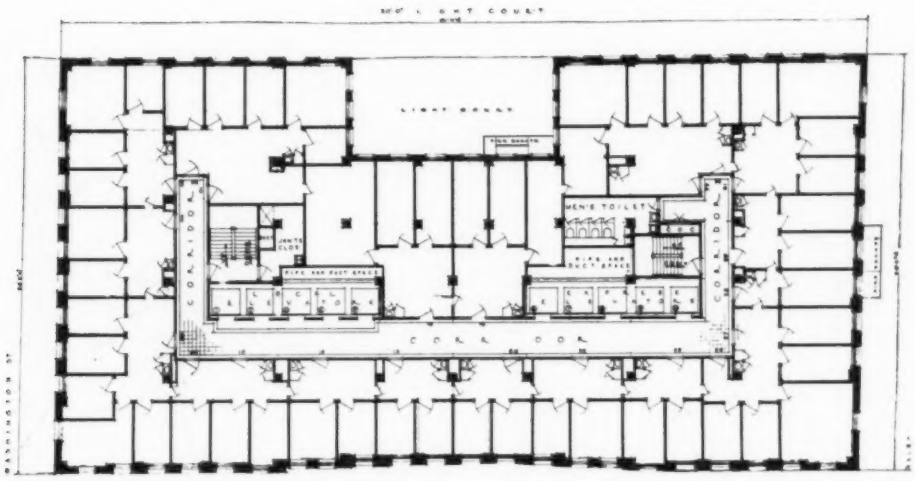


Photo. Chicago Architectural Photographing Co.

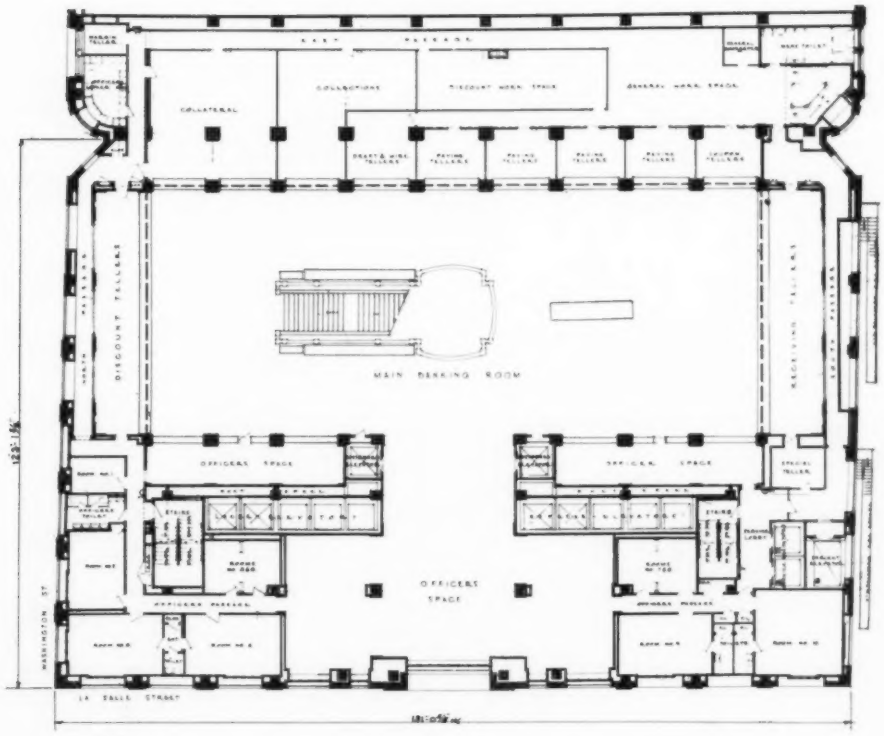
ENTRANCE STAIRS LEADING TO BANKING ROOM

FOREMAN STATE NATIONAL BANK BUILDING, CHICAGO

GRAHAM, ANDERSON, PROBST AND WHITE, ARCHITECTS



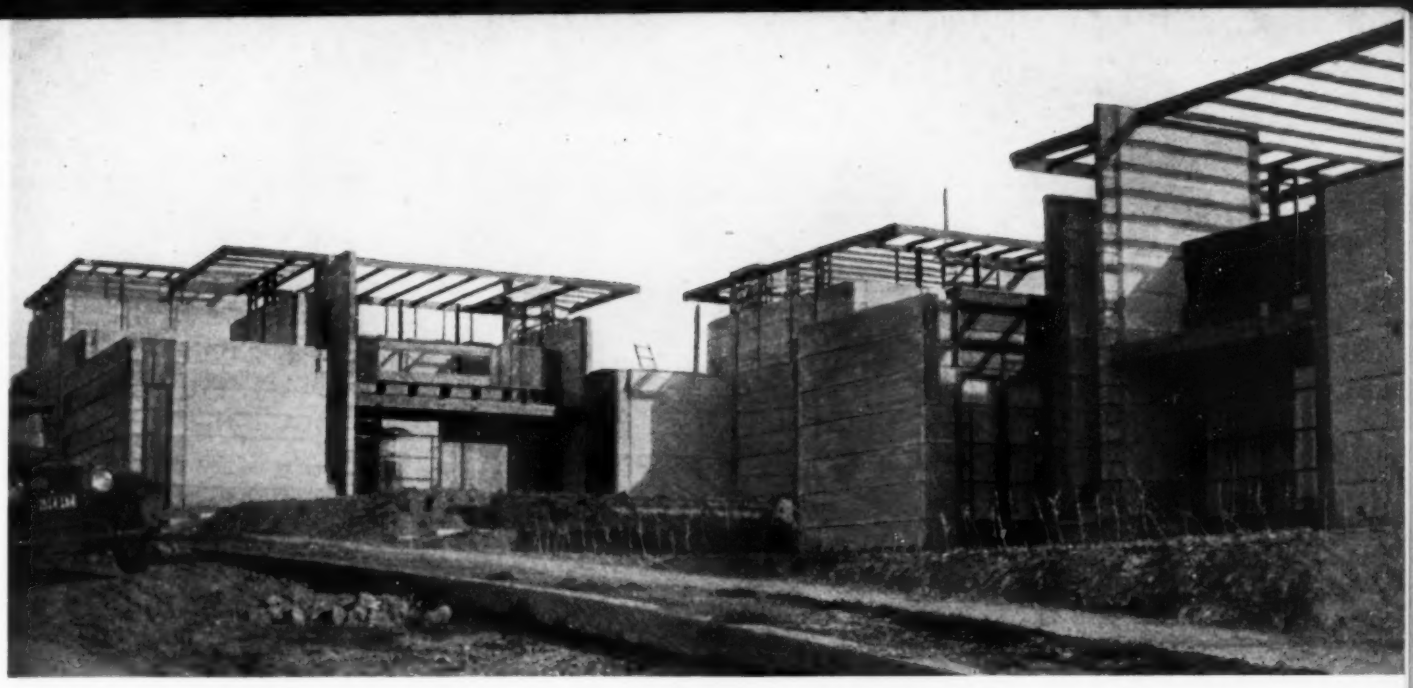
TYPICAL FLOOR PLAN



SECOND FLOOR PLAN

FOREMAN STATE NATIONAL BANK BUILDING, CHICAGO

GRAHAM, ANDERSON, PROBST AND WHITE, ARCHITECTS



HOUSES FOR OUTDOOR LIFE

A Vacation Settlement on the Pueblo Ribera, La Jolla, California

R. M. SCHINDLER, ARCHITECT

THE LOCATION

A sloping piece of ground close to the shores of the Pacific Ocean, on the southern end of La Jolla, facing two parallel streets and bisected by a public alley.

•

THE PROGRAM

Dr. W. L. Lloyd decided to build a group of twelve houses including garages for rental to summer vacationists. The utmost economy was necessary to meet the competition of the customary primitive wooden beach shack.

•

THE LAYOUT

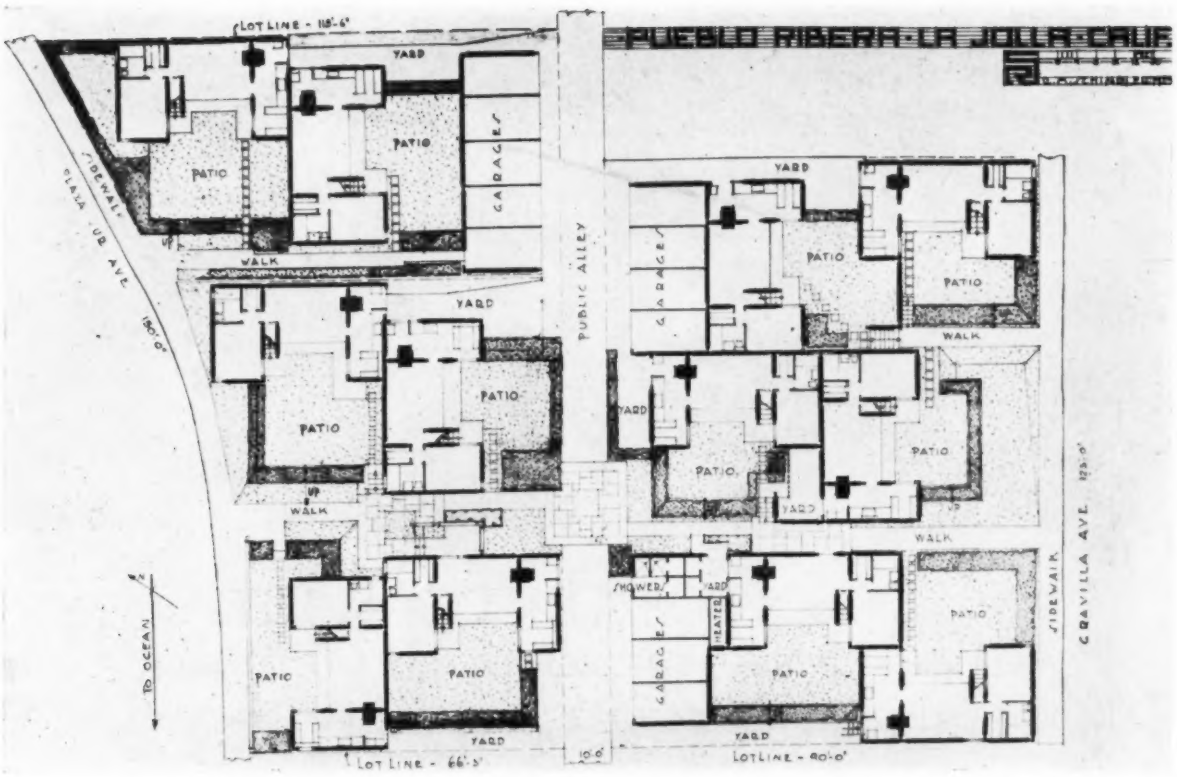
In order to facilitate extensive outdoor life a play court for each house was considered necessary. The single house unit is repeated twelve times. The units are arranged to give complete privacy to the play courts in front of the living rooms. In no case do a neighbor's windows open into a court. Each house has a roof terrace surrounded by a parapet of sufficient height to assure privacy. Each roof terrace is equipped with a fireplace and looks freely out toward the ocean. The garages are accessible from the public alley. A central gas heater and circulating system provide hot water for all dwellings. A group of public showers serve the bathers returning from the beach.

The court side of each living room is formed by sliding glass doors which may be opened full length. High windows on the other side of the room open out above the lower side portions of the house. Their location right below the ceiling insures ample light and ventilation and serves to counteract the effects of the sun on the roof terrace. Each living room has a real fireplace; a couch and a closet permit its use as a guest room. Each kitchen is equipped with an icebox and a garbage incinerator.

•

STRUCTURAL SCHEME

All floors are made of concrete and laid right on the ground. The roofs are constructed of wood joists covered with shiplap and composition roofing. The roof terrace is formed by a concrete slab laid on top of the roofing. All walls are made of concrete by a "slab-cast" scheme. It is a



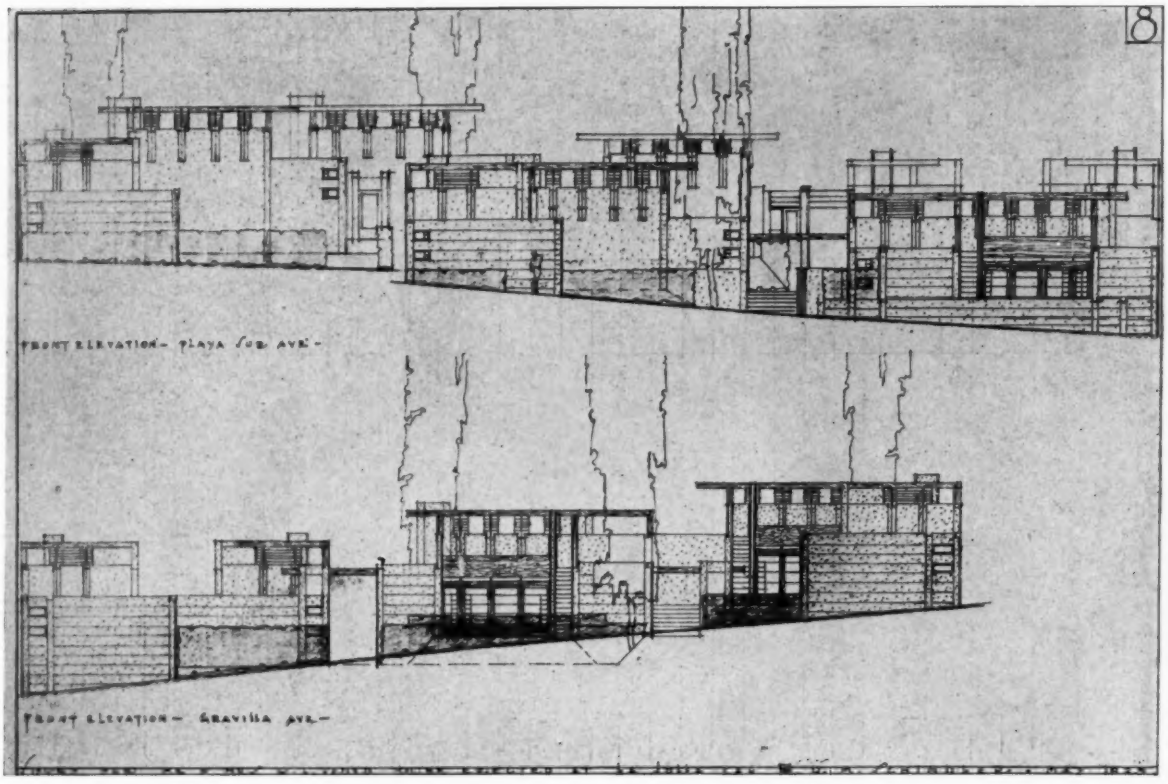
PLOT PLAN OF DEVELOPMENT
PUEBLO RIBERA, LA JOLLA, CALIFORNIA
R. M. SCHINDLER, ARCHITECT

type of monolithic concrete wall construction suitable for one- and two-story buildings. In climates colder than California some added provision for heat insulation should be made.

The "slab-cast" form work is made of wood and consists of a skeleton of vertical guides and a single continuous course of horizontal wall forms. The guides are two inches thick and have bevelled edges to help the stripping. The wall forms slide on the outside of the guides. They are made of two-inch boards held together by cleats. The inside is covered with roofing paper in order to insure a good surface for the concrete. A small triangular wood strip holds the paper in place and gives a clean cut seam for each course of concrete. The forms are pressed against the guides by means of the cleats and iron clamps.

The concrete floor is placed and finished first. The guides are then erected. Next the window and door frames, anchors, reinforcing rods including special ties at corners, plumbing pipes, etc., are placed between the forms. No cutting of formwork is necessary. One course of concrete is poured each day. The concrete is poured during the afternoon, allowing it to set overnight sufficiently to permit the raising of the forms the next morning. The forms are loosened by opening the clamps and then they are slid up to the next course. Long heavy form units are handled by means of block and tackle fastened to the cross braces on top of the guides.

The concrete used need be only of low strength (500 lbs.). Often suitable aggregate for such concrete is found right on the premises. The form lumber, being two inches thick, is not damaged and so is available for structural purposes. Two sets of forms only were used for the Pueblo Ribera. After forms are once made, unskilled labor



WORKING DRAWINGS
PUEBLO RIBERA, LA JOLLA, CALIFORNIA
R. M. SCHINDLER, ARCHITECT

is sufficient for the handling. No plastering of walls is required either inside or outside.

•

ARCHITECTURAL DESIGN

An attempt was made to achieve an organic whole out of the aggregation of small units. The grouping serves to overcome the appearance of a mechanical repetition of units so frequent in similar schemes. Each house receives an individual character through its position in relation to its neighbor and through variations in the design of the woodwork above the openings and in the roof pergola. The neighbor's windowless back walls become attractive garden features. Roof terrace, play court and living room join to form one living space. A uniform scale is maintained throughout by using a scheme of equally spaced unit lines for the whole layout.

Each house is apparently formed by a series of upright slab units. The slab units used to form the enclosure are made of concrete, and those used to screen the openings are composed of wood and glass. All these slab units are joined by recessed links, which result from the use of the form guides. The small horizontal grooves between the courses of the wall do not appear on the links and do not contradict the monolithic character of the slab unit. Architecturally the recessed links are as characteristic of the modern slab wall as the plaster was of the traditional plastic masonry wall.

•

MATERIALS

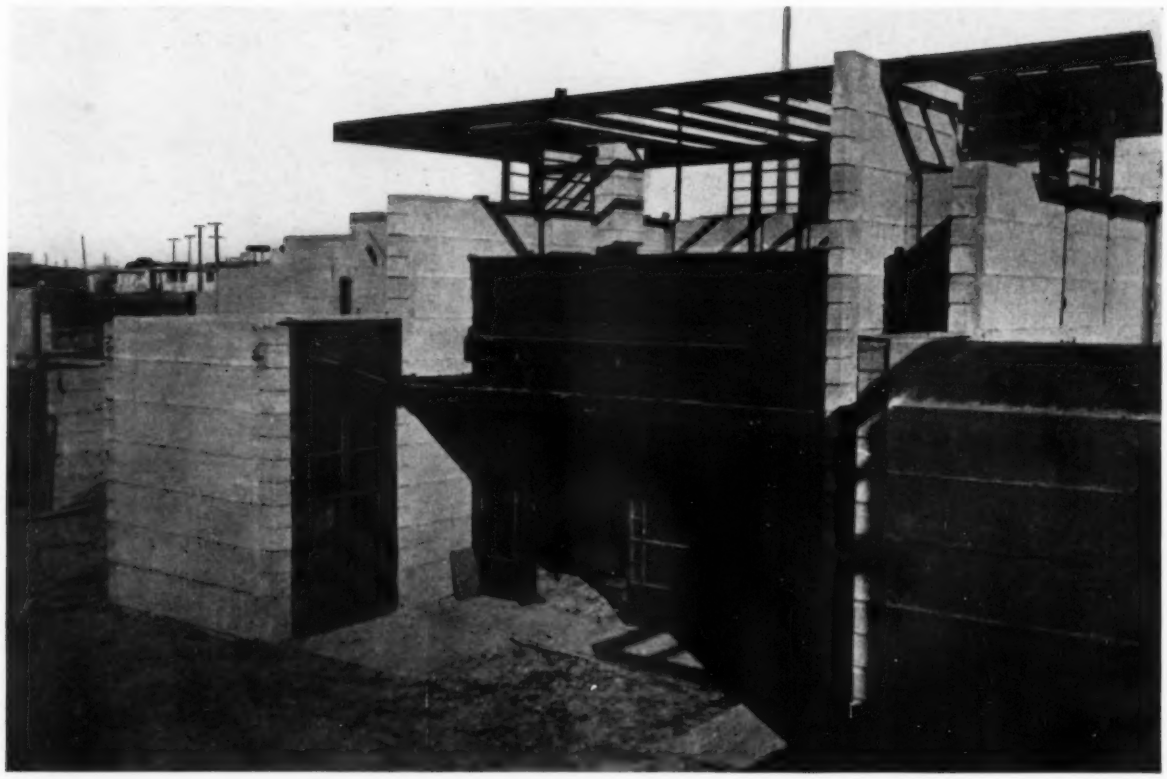
Concrete for all floors and walls.

California Redwood for all exposed wood including furniture.

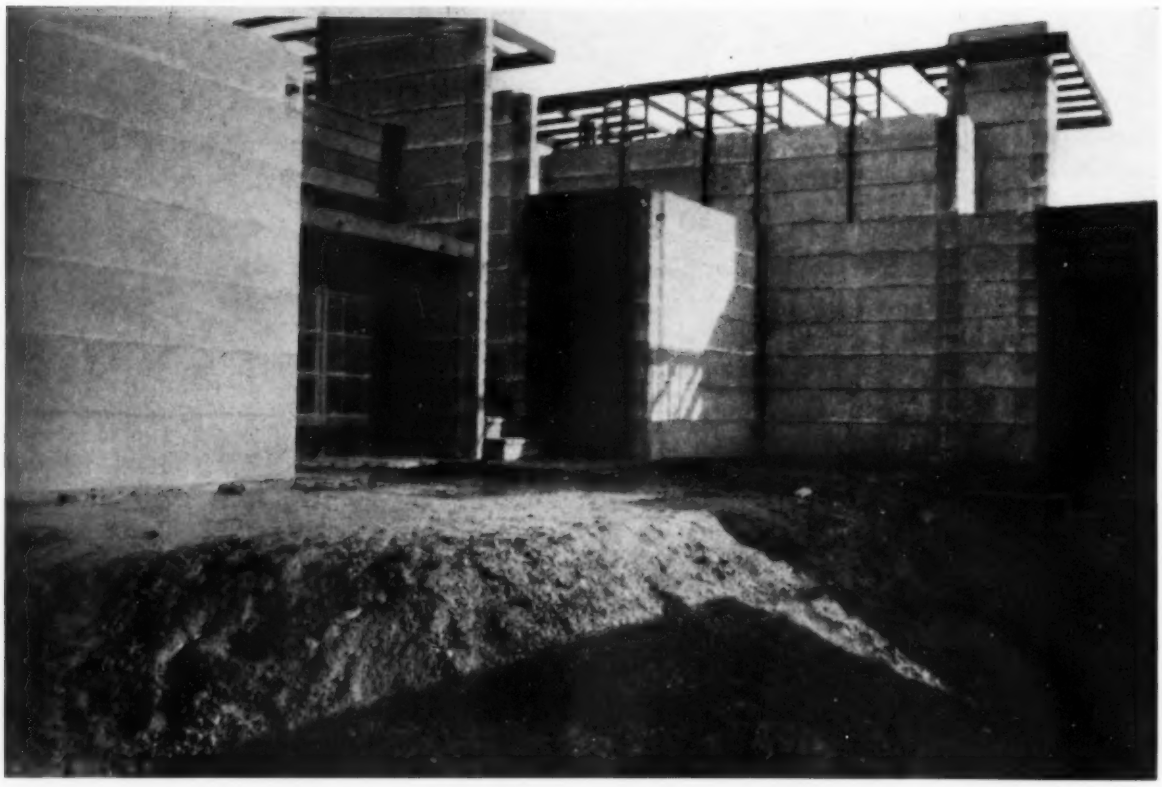
Celotex for the ceiling panels between rafters of living room.

Composition roofing.

Glass.



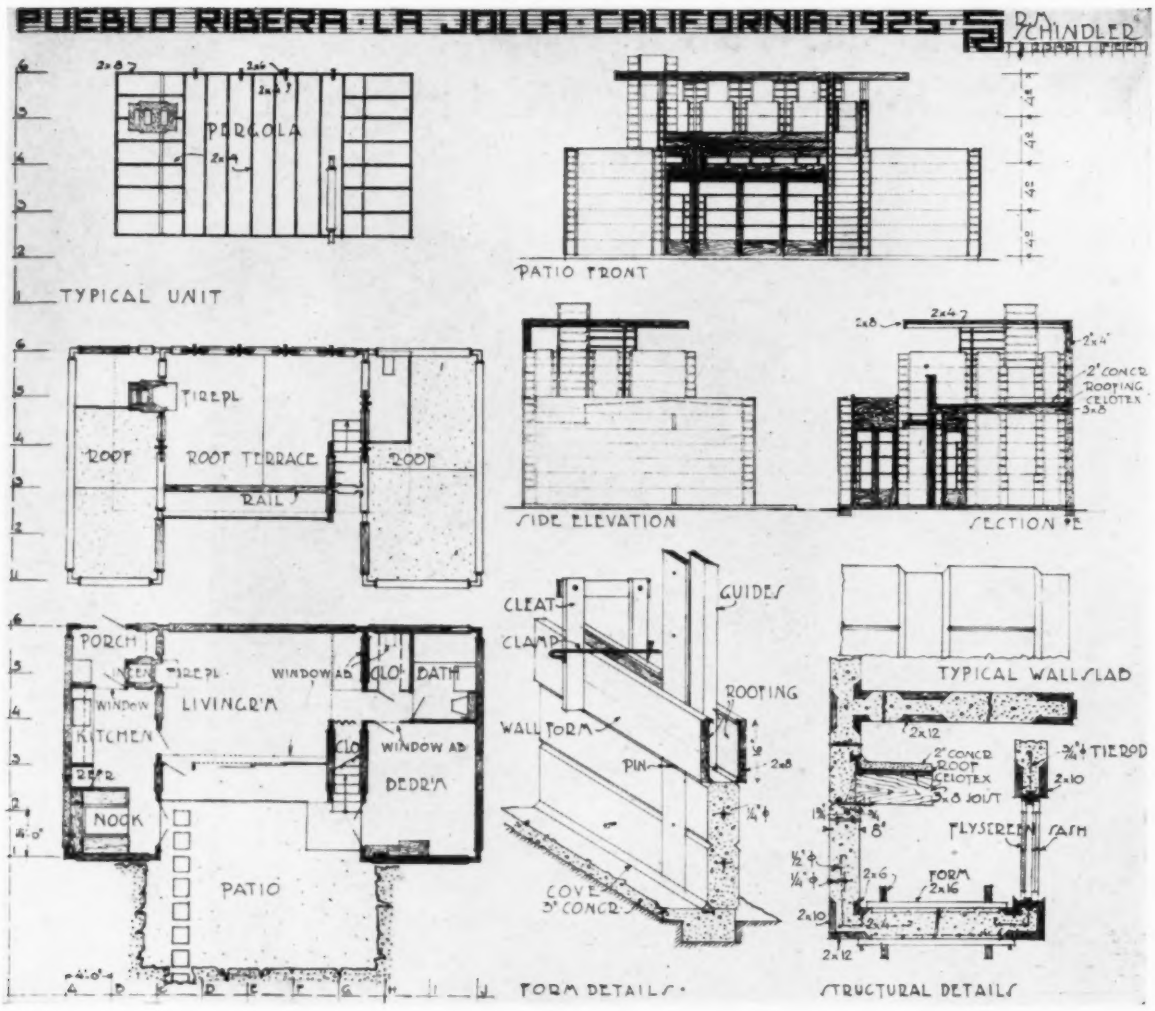
VIEW OF FRONT ELEVATION



A TYPICAL UNIT

PUEBLO RIBERA, LA JOLLA, CALIFORNIA

R. M. SCHINDLER, ARCHITECT



CONSTRUCTION DETAILS

PUEBLO RIBERA, LA JOLLA, CALIFORNIA

R. M. SCHINDLER, ARCHITECT

TEXTURES

Cast concrete, medium rough. Surfaced wood. Glass.

•

COLOR

Concrete Stain (acid): tan to terra cotta.

Waxed Natural California Redwood: brown red.

Natural Celotex: tan.

•

LANDSCAPING

The planting scheme carries the layout of the house into the open. Lawn courts surrounded by salt bush hedges. Torrey pines at entrances. Climbing vines for walls and pergolas.

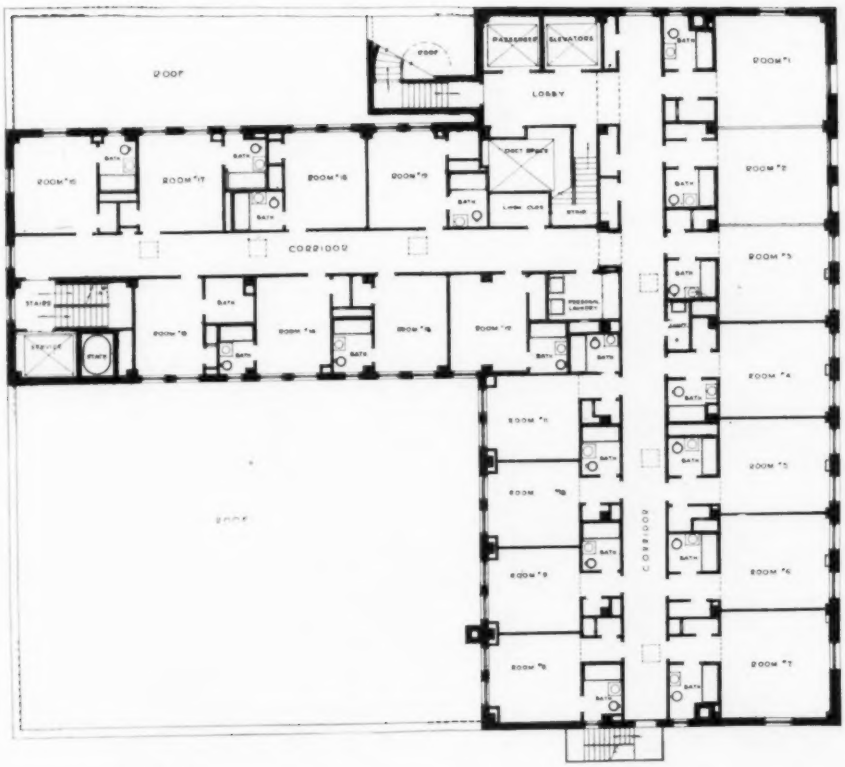
•

INTERIOR VIEWS OF THE WOMEN'S CLUB OF CHICAGO

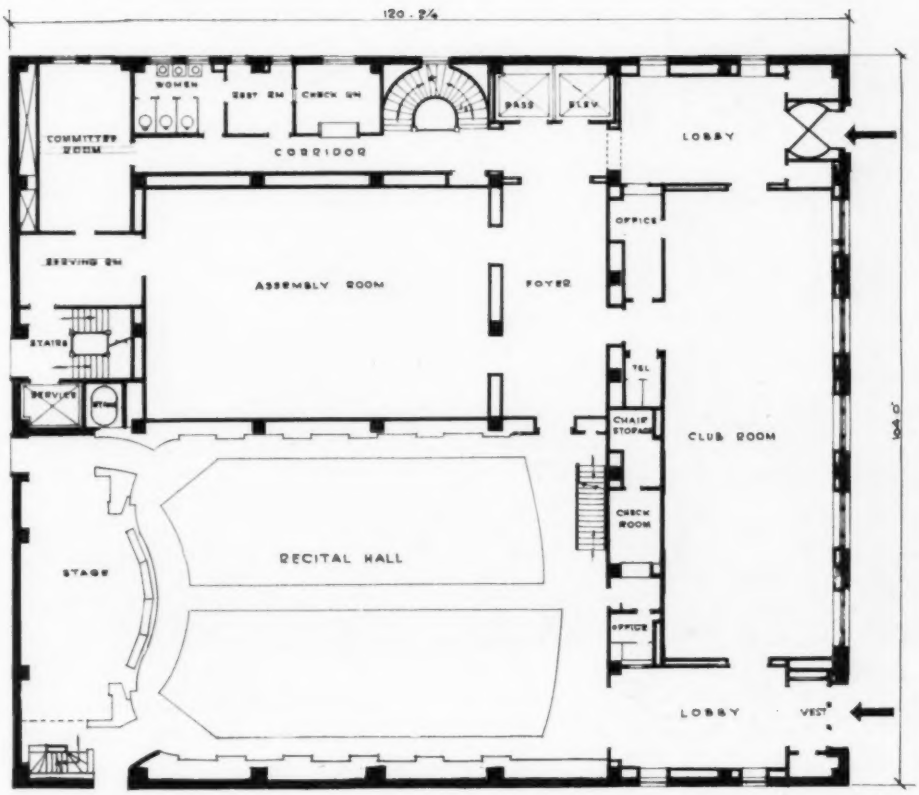
HOLABIRD AND ROOT, ARCHITECTS

WOMEN'S CLUB OF CHICAGO
HOLABIRD AND ROOT, ARCHITECTS

Club Lounge, with Gold Damask Hangings and Block-Patterned Carpet in Wood Tones

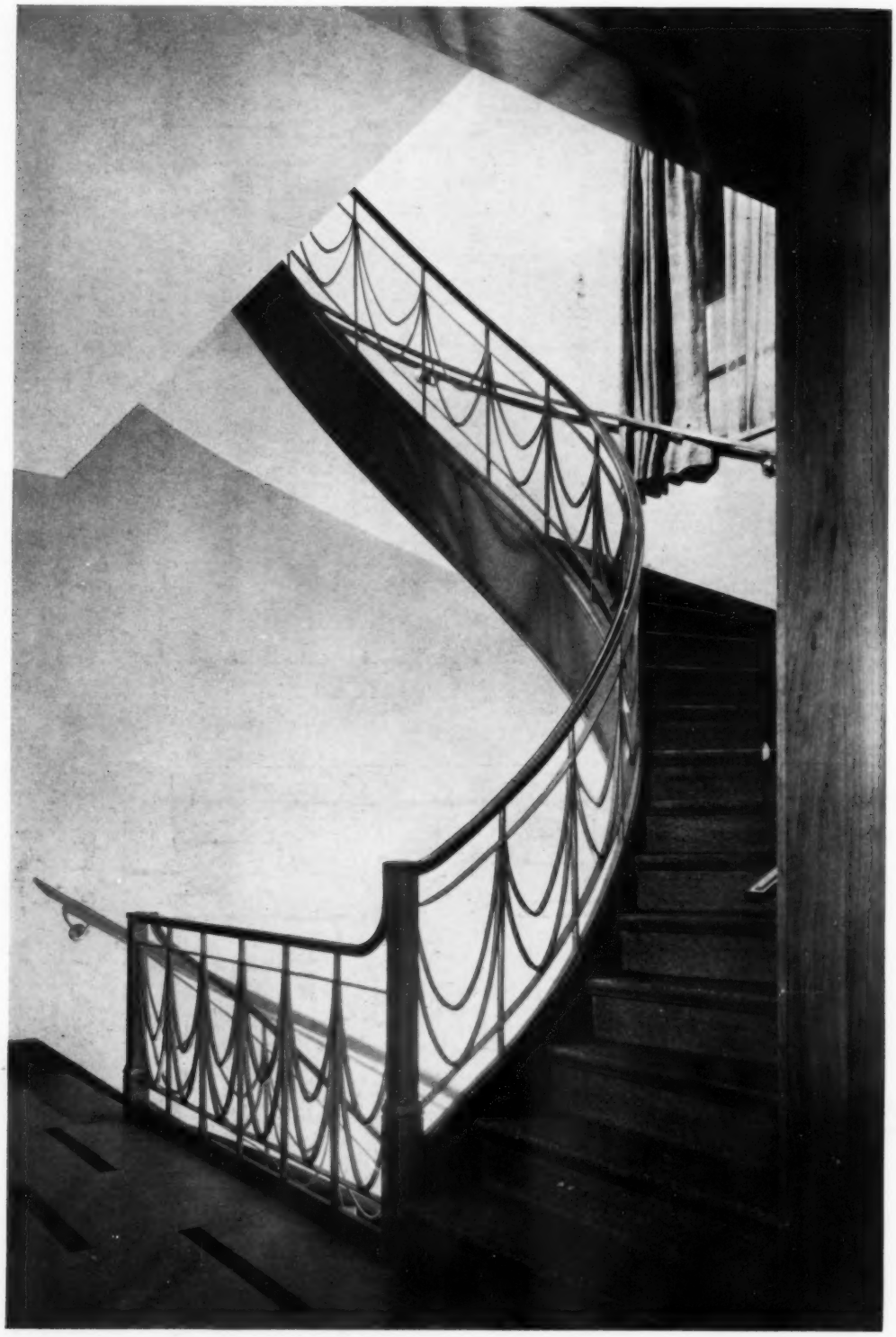


TYPICAL FLOOR PLAN



FIRST FLOOR PLAN
CHICAGO WOMEN'S CLUB

HOLABIRD & ROOT
ARCHITECTS



WOMEN'S CLUB OF CHICAGO
HOLABIRD AND ROOT, ARCHITECTS

Stairway Between Second and Third Floors, Finished in Silver

Corner of Breakfast or Small Private Dining Room, with Sun Yellow Walls and Pistachio Green Taffeta Draperies

WOMEN'S CLUB OF CHICAGO
HOLABIRD AND ROOT, ARCHITECTS

WOMEN'S CLUB OF CHICAGO
HOLABIRD AND ROOT, ARCHITECTS

Directors' Room, with Violet Satin Draperies and Carpeting, and Accents of Green in Wall Paper and Chair Upholstery

Corridor Adjoining First Floor Lobby

WOMEN'S CLUB OF CHICAGO
HOLABIRD AND ROOT, ARCHITECTS

WOMEN'S CLUB OF CHICAGO
HOLABIRD AND ROOT, ARCHITECTS

PORTFOLIO OF CURRENT ARCHITECTURE

FULTON STREET SCHOOL, HEMPSTEAD, N. Y.
ERNEST SIBLEY, ARCHITECT

FEATURING SCHOOL BUILDINGS

Photo. R. S. Grant

FULTON STREET SCHOOL, HEMPSTEAD, N. Y.

ERNEST SIBLEY, ARCHITECT

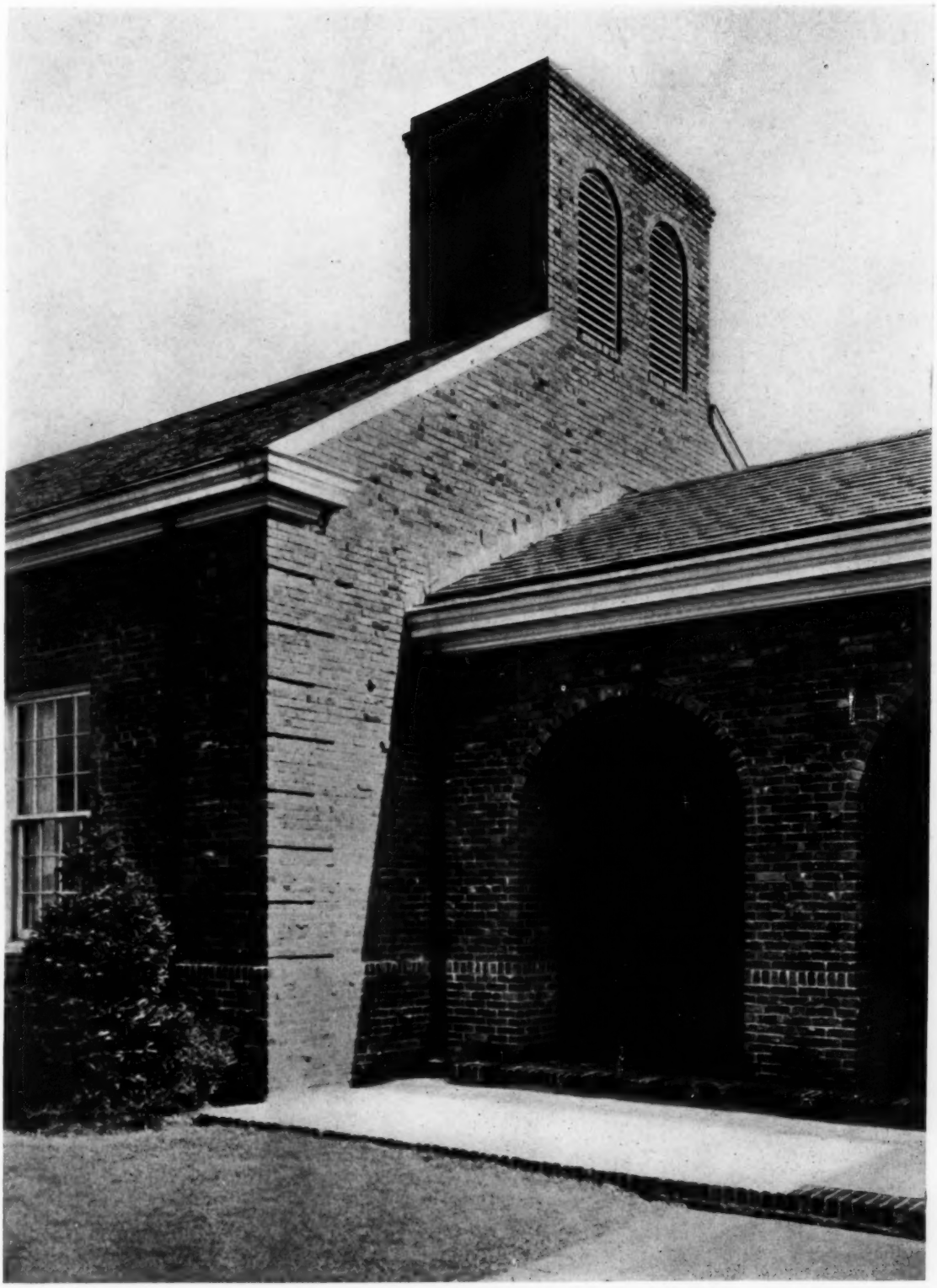


Photo. R. S. Grant

FULTON STREET SCHOOL, HEMPSTEAD, N. Y.

ERNEST SIBLEY, ARCHITECT

Photo, R. S. Grant

FRANKLIN STREET SCHOOL, HEMPSTEAD, N. Y.

ERNEST SIBLEY, ARCHITECT

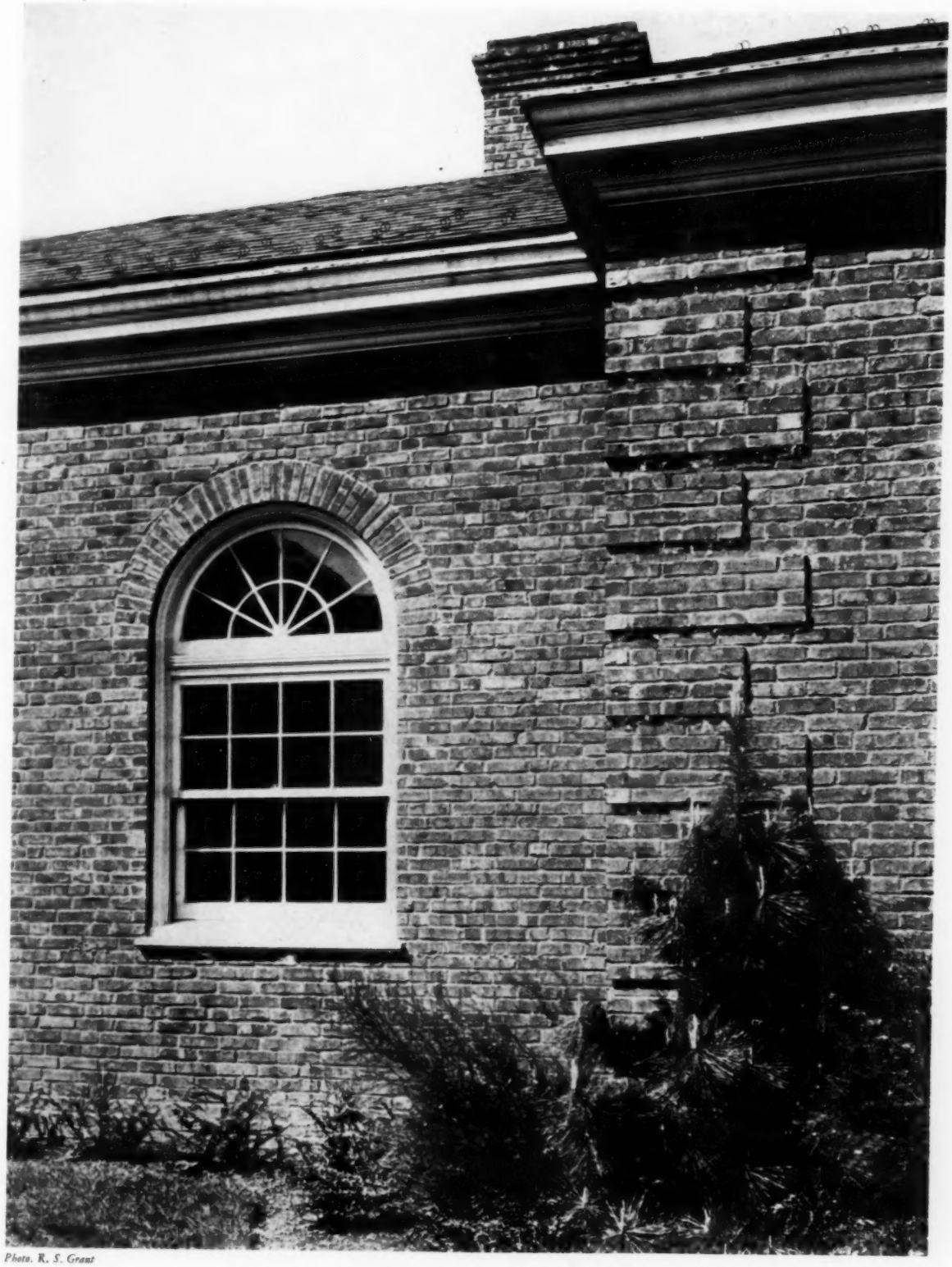


Photo. R. S. Grant

FRANKLIN STREET SCHOOL, HEMPSTEAD, N. Y.

ERNEST SIBLEY, ARCHITECT

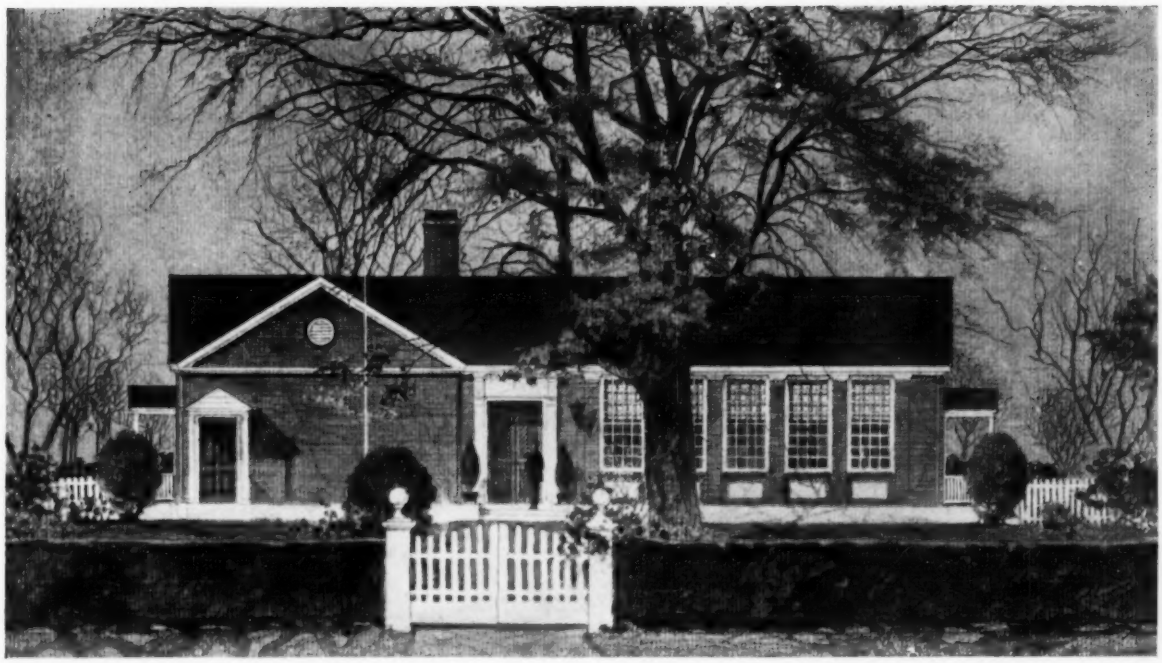
GENERAL VIEW

Photos. R. S. Grant

ENTRANCE DETAIL

FRANKLIN STREET SCHOOL, HEMPSTEAD, N. Y.

ERNEST SIBLEY, ARCHITECT



DESIGN OF A SMALL RURAL SCHOOL HOUSE

RALPH HARRINGTON DOANE, ARCHITECT

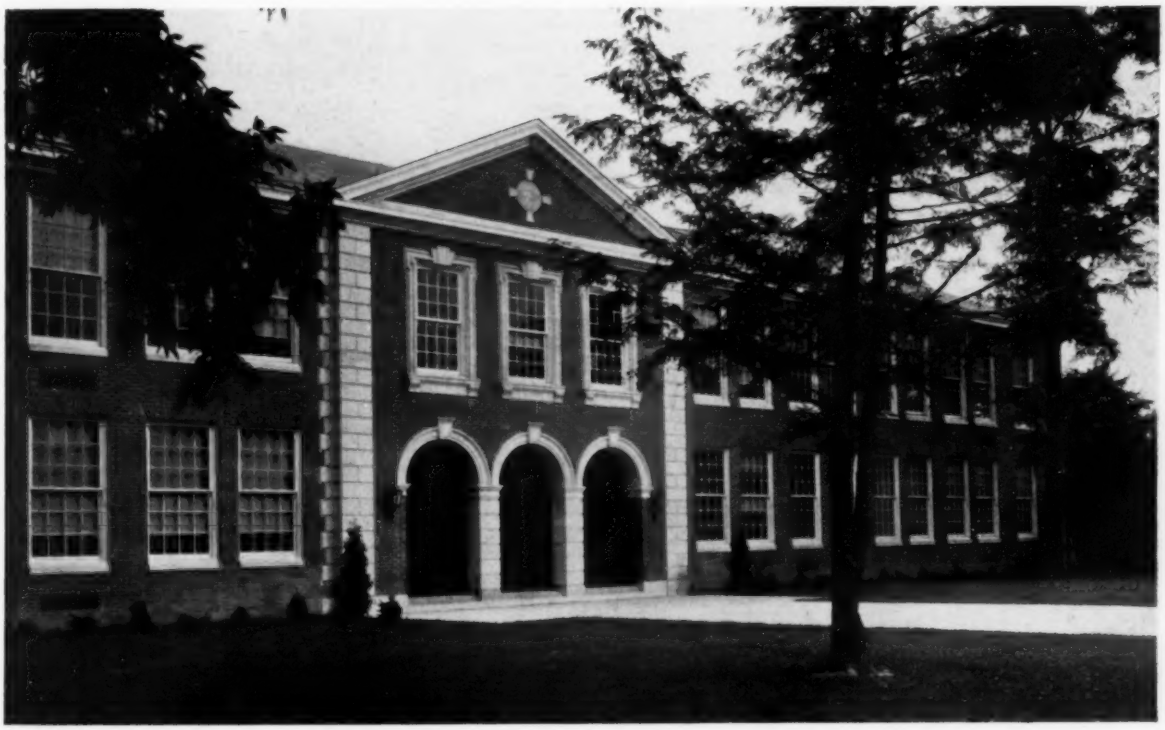
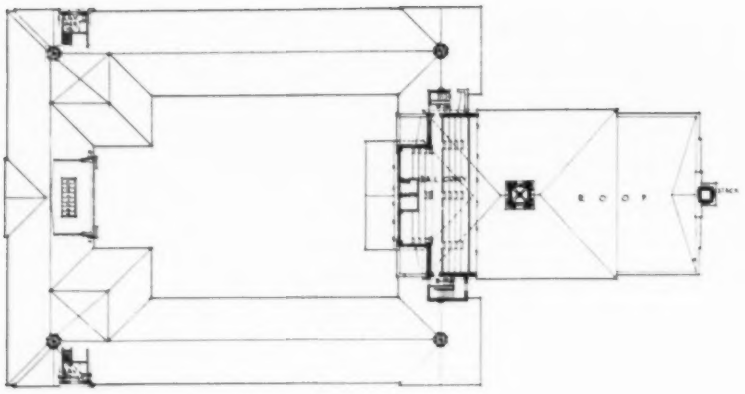


Photo. Wallace

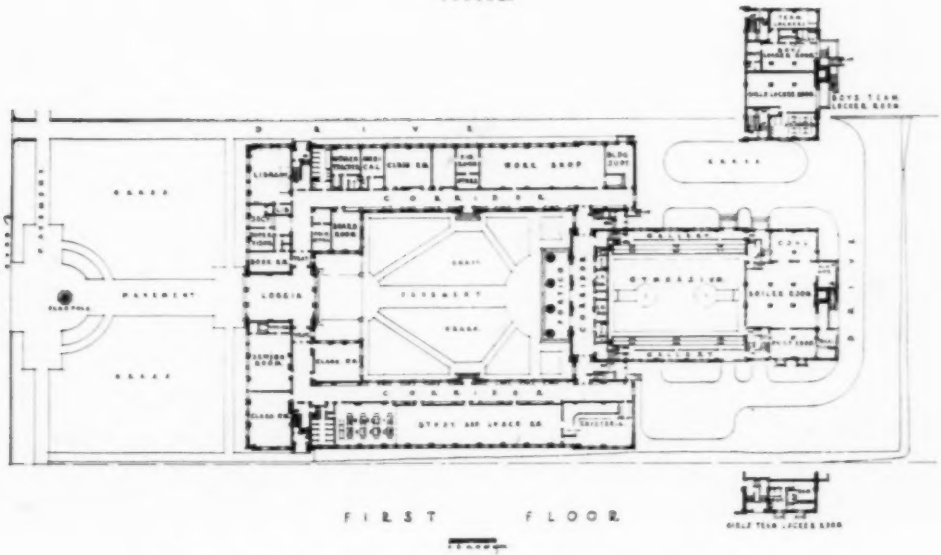
MEMORIAL HIGH SCHOOL, HADDONFIELD, N. J.

SIMON AND SIMON, ARCHITECTS



BALCONY AND ROOF PLAN

SECOND FLOOR

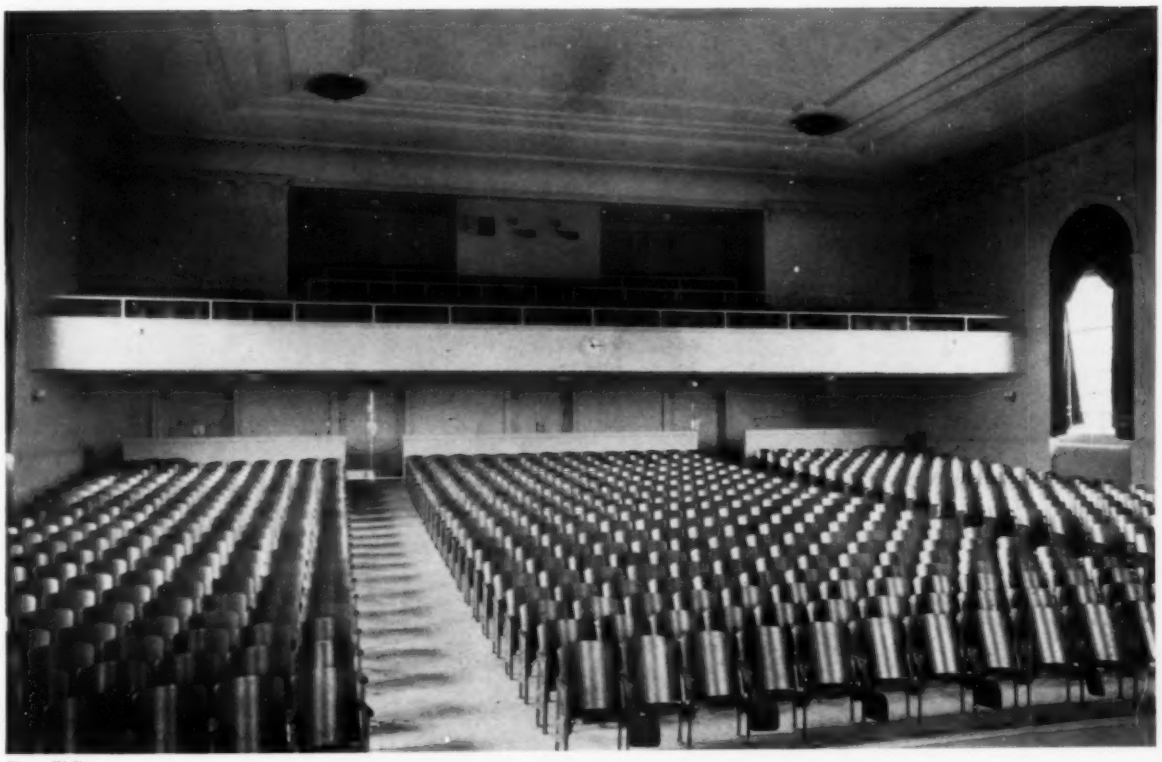


FIRST FLOOR

MEMORIAL HIGH SCHOOL, HADDONFIELD, N. J.

SIMON AND SIMON, ARCHITECTS

CORRIDOR LIGHTED FROM COURTYARD



Photos, Wallace

MEMORIAL HIGH SCHOOL, HADDONFIELD, N. J.

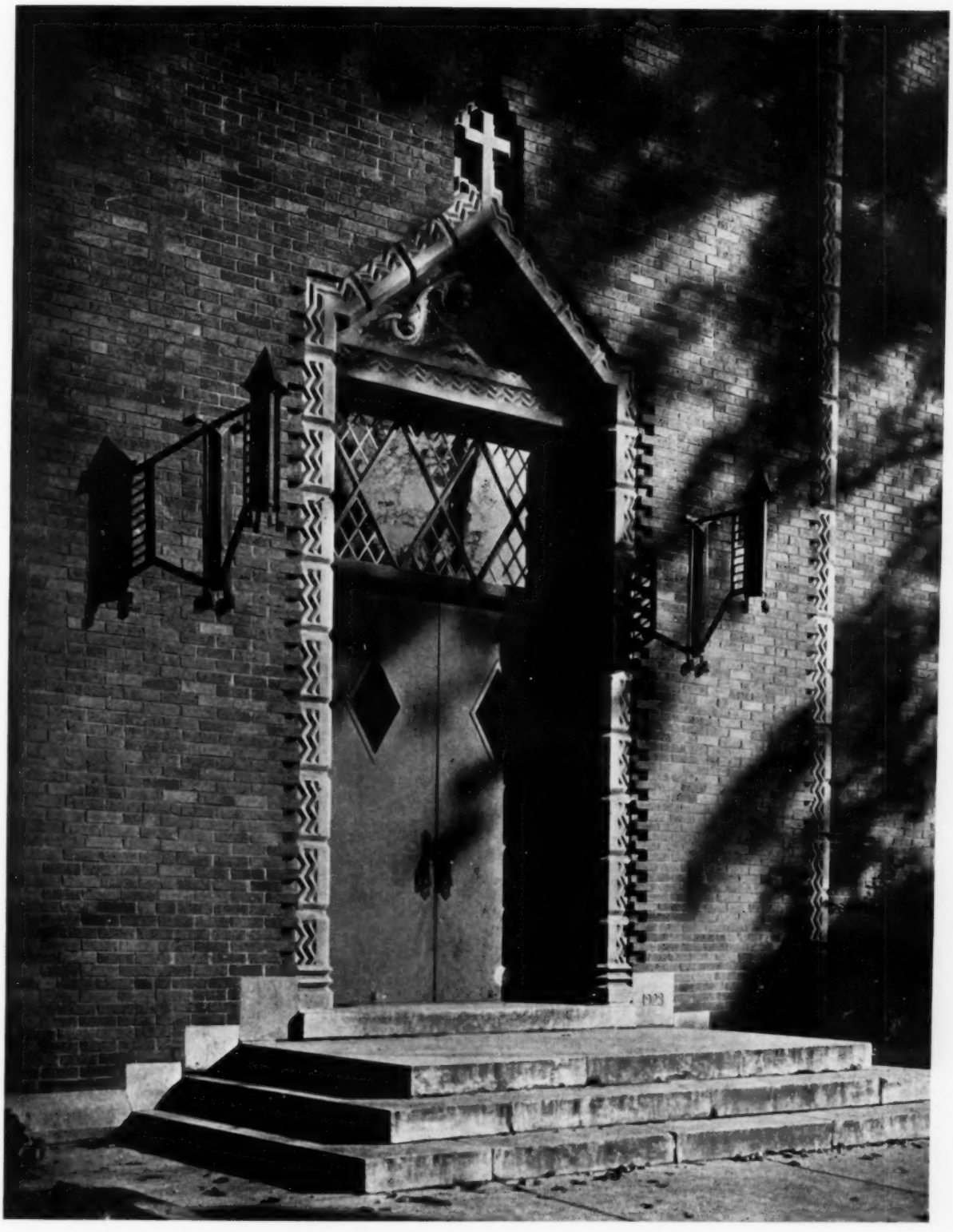
SIMON AND SIMON, ARCHITECTS

Photo. Wallace

VIEW OF ENTRANCE GATEWAY FROM COURTYARD

MEMORIAL HIGH SCHOOL, HADDONFIELD, N. J.

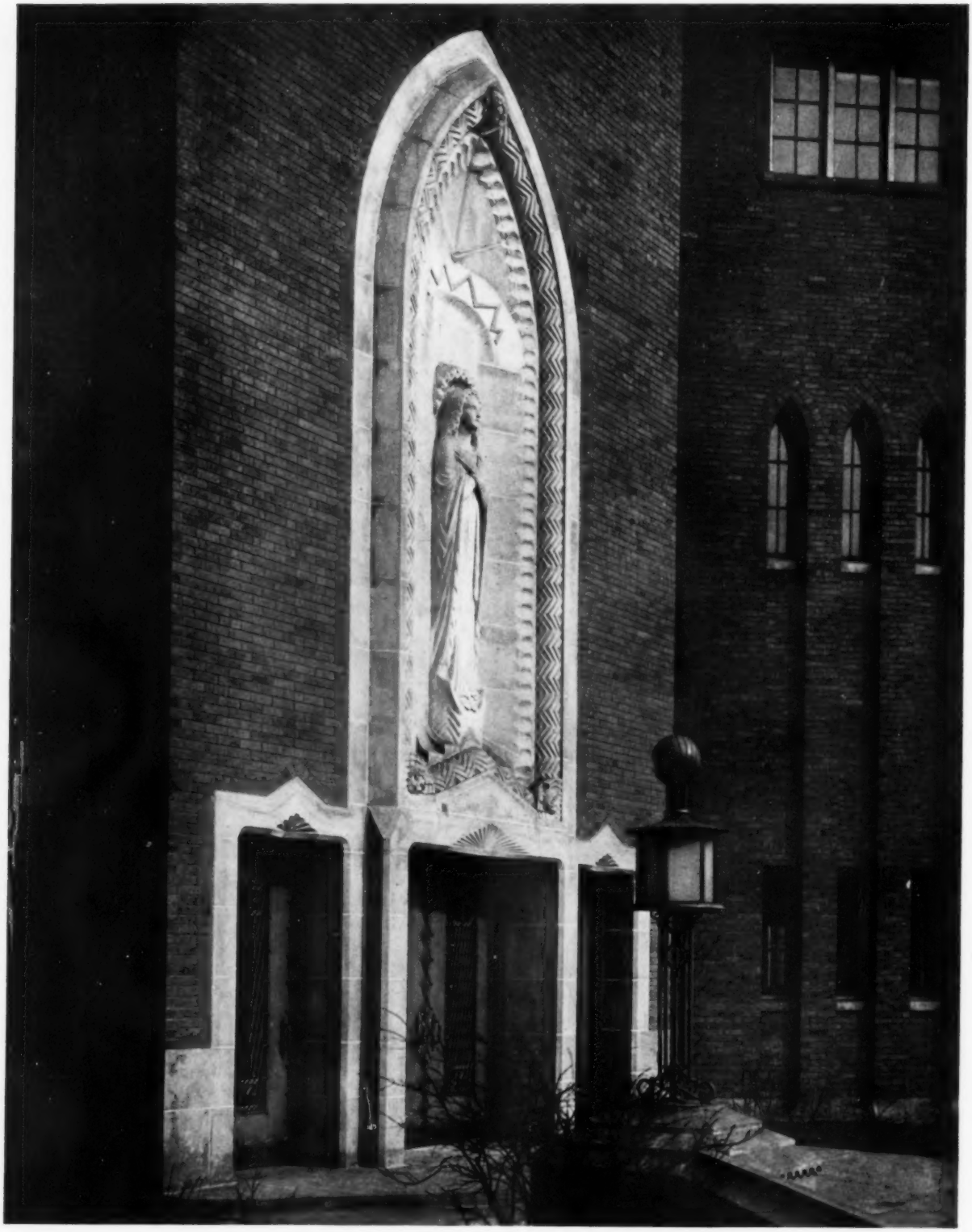
SIMON AND SIMON, ARCHITECTS



ENTRANCE DOOR WITH ORNAMENTAL WORK IN CAST STONE

SCHOOL OF ST. FRANCIS XAVIER, WILMETTE, ILL.

ALFONSO IANNELLI, SCULPTOR



IMMACULATA HIGH SCHOOL, CHICAGO

BARRY BYRNE, ARCHITECT

ALFONSO IANNELLI, COLLABORATING SCULPTOR

ST. MARY'S HIGH SCHOOL, CHICAGO

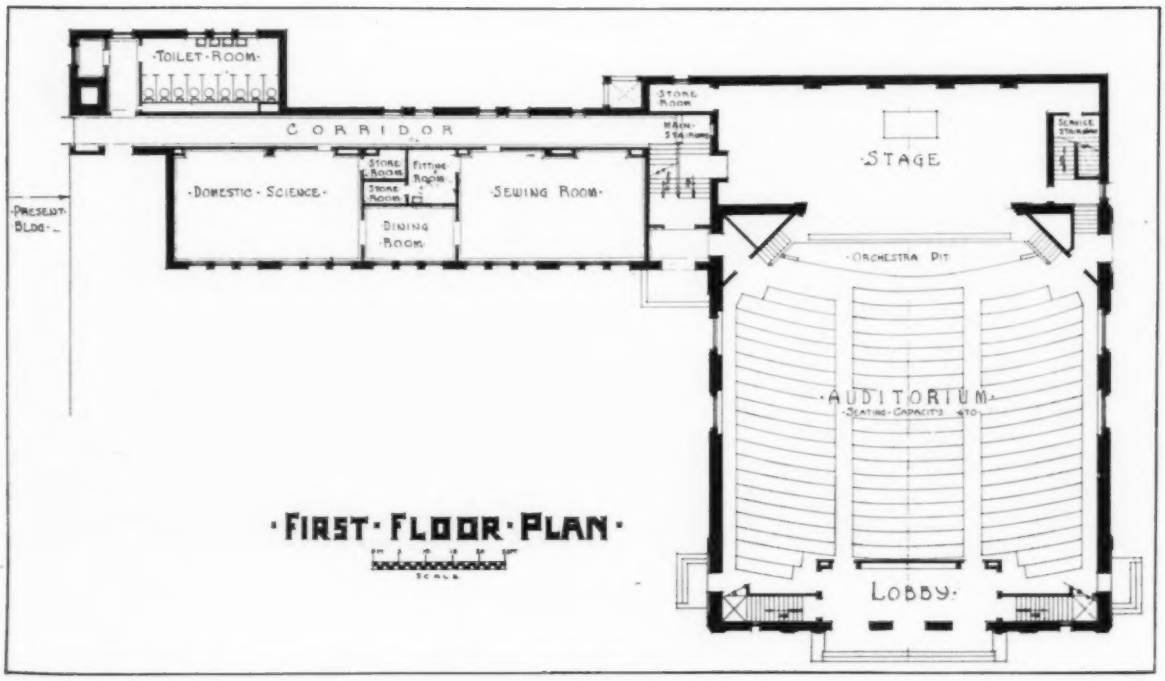
BARRY BYRNE, ARCHITECT

ALFONSO IANNELLI, COLLABORATING SCULPTOR

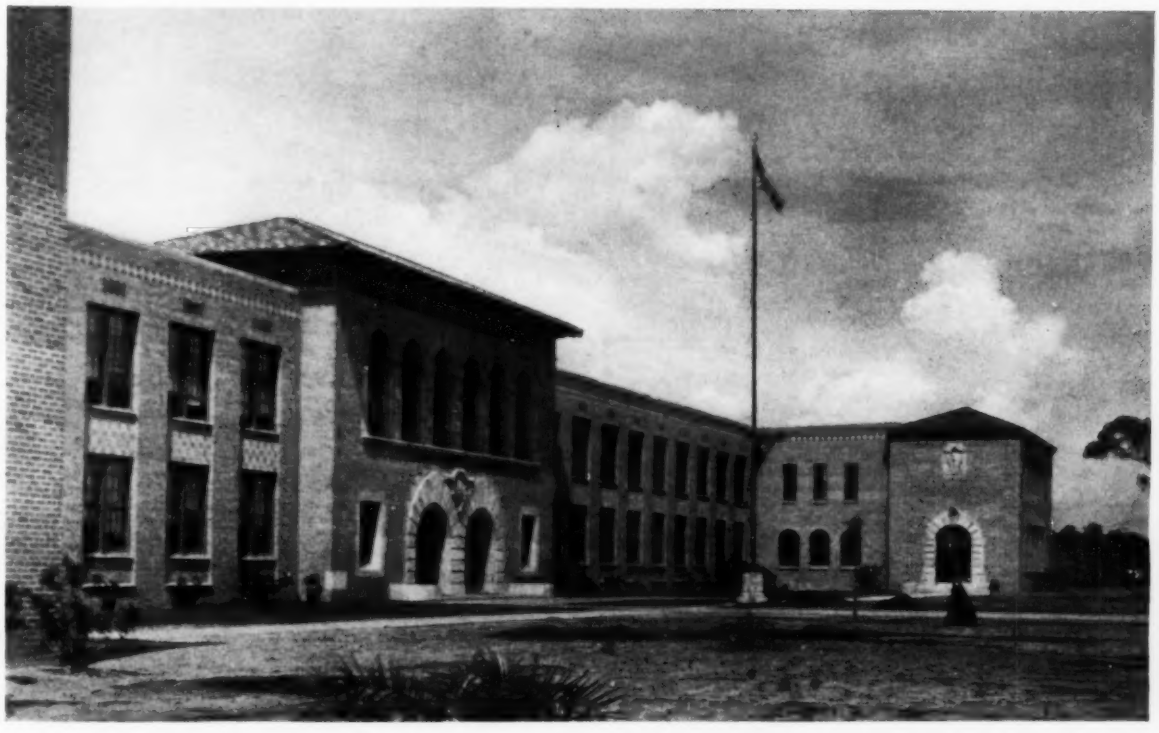
AUDITORIUM

ST. MARY'S HIGH SCHOOL, CHICAGO

BARRY BYRNE, ARCHITECT



ENTRANCE



HENRY B. PLANT HIGH SCHOOL, TAMPA, FLORIDA

FRANKLIN O. ADAMS, ARCHITECT

JEFFERSON M. HAMILTON, ASSOCIATE ARCHITECT

Photo. Gottscho

UNION FREE SCHOOL, COLD SPRING HARBOR, N. Y.

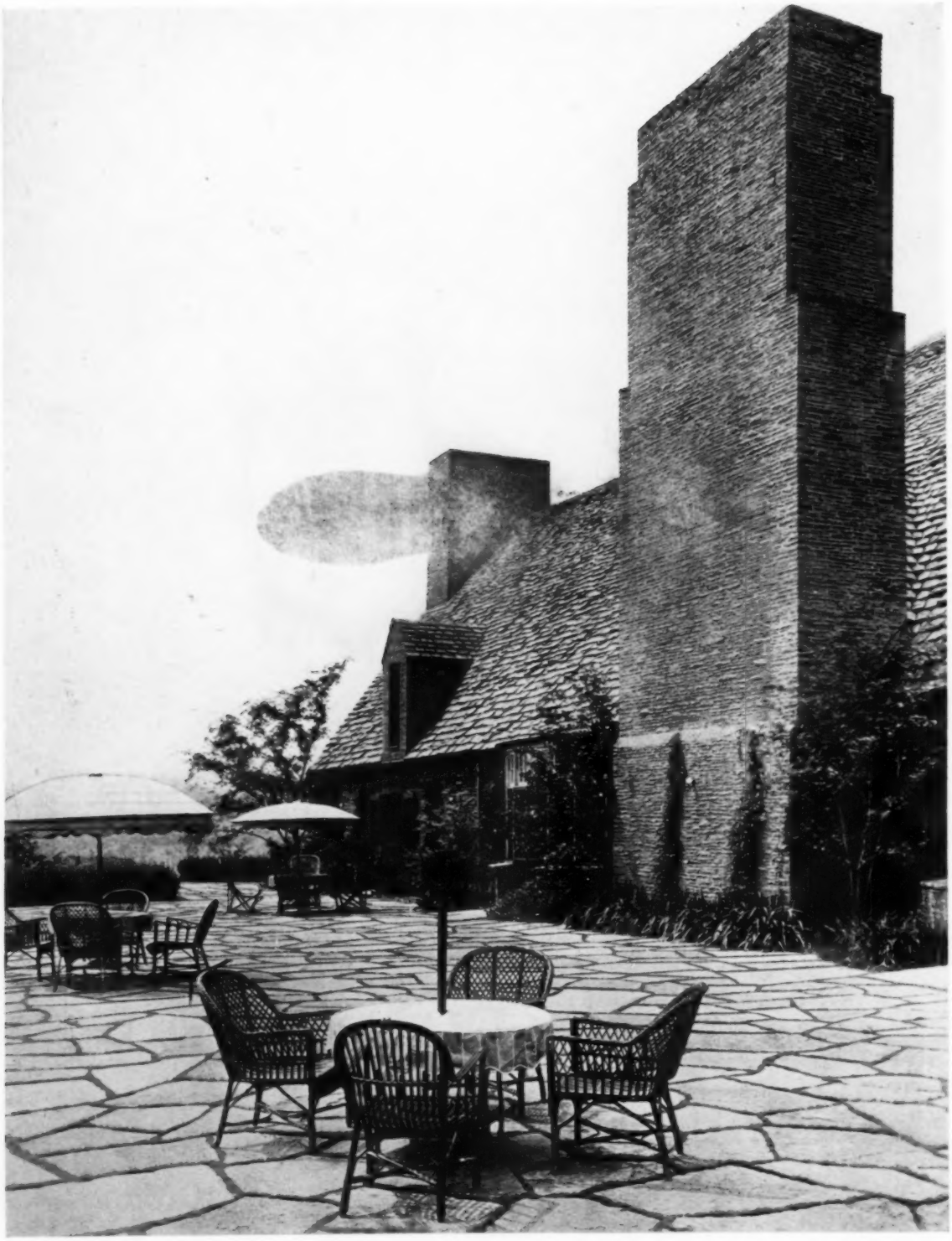
PEABODY, WILSON AND BROWN, ARCHITECTS

GROUND FLOOR PLAN

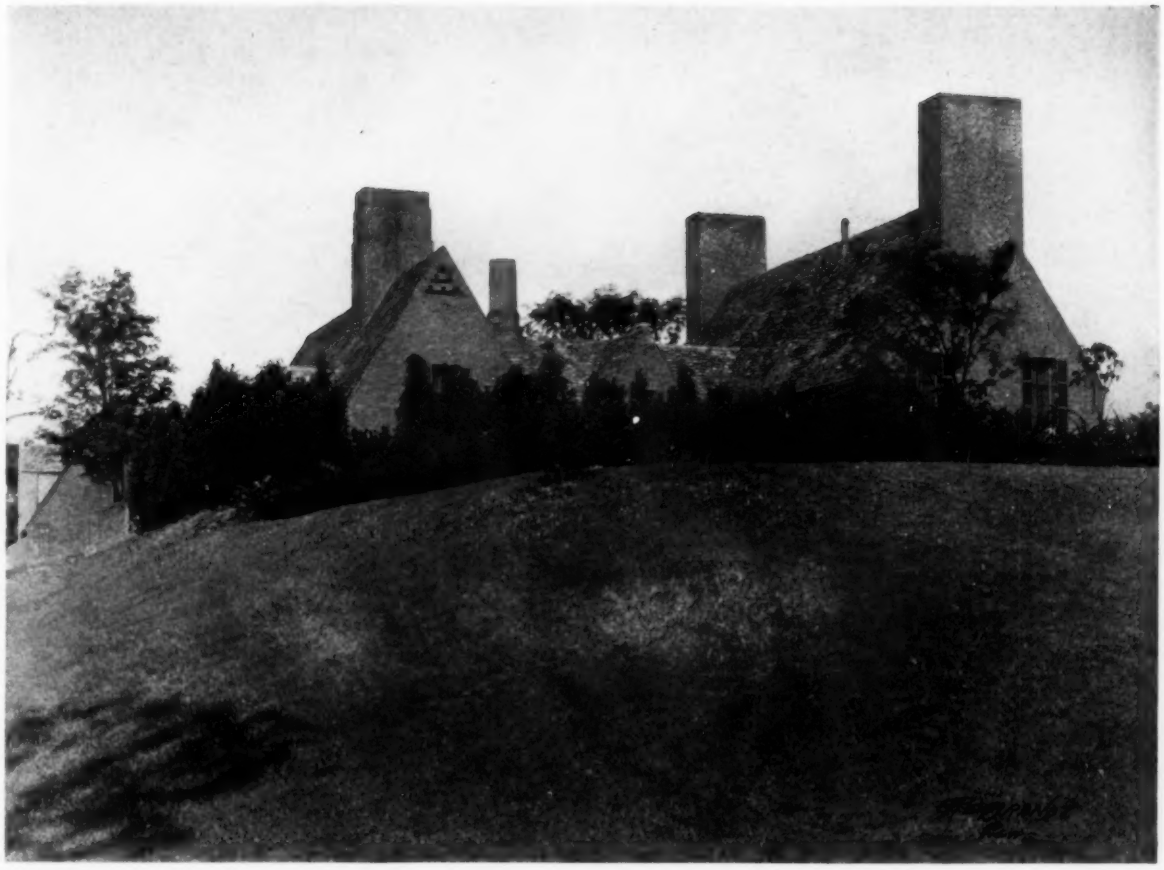
Photo. Rembrandt Studios

LONGUE VUE COUNTRY CLUB, PITTSBURGH, PA.

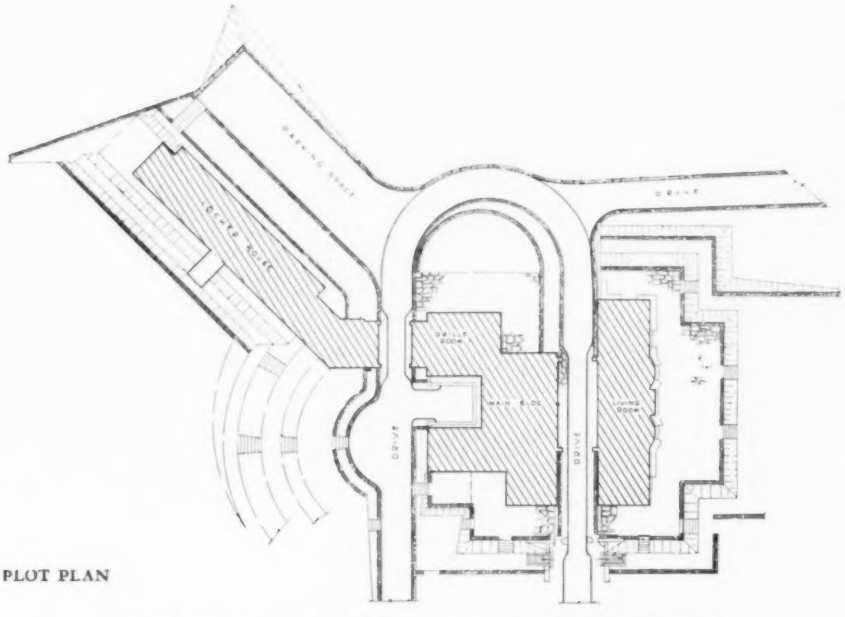
JANSSEN AND COCKEN, ARCHITECTS



LONGUE VUE COUNTRY CLUB, PITTSBURGH, PA.
JANSSEN AND COCKEN, ARCHITECTS



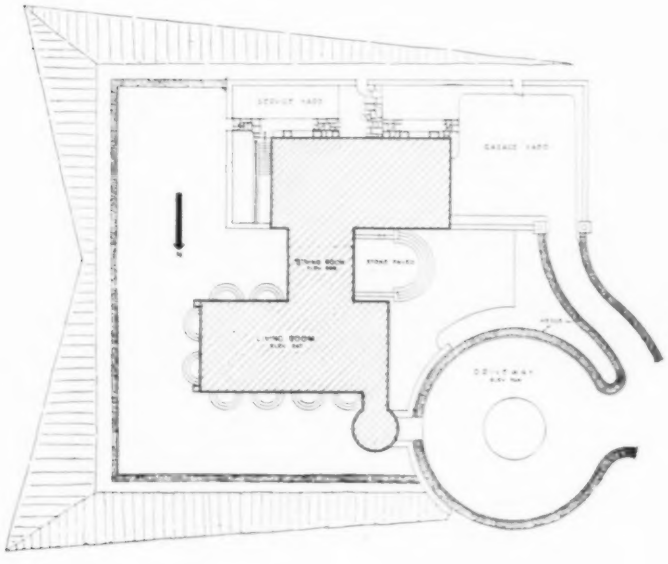
HOUSE FOR MR. EDGAR J. KAUFMANN, PITTSBURGH, PA.
JANSSEN AND COCKEN, ARCHITECTS



PLOT PLAN

LONGUE VUE COUNTRY CLUB, PITTSBURGH, PA.
JANSSEN AND COCKEN, ARCHITECTS

HOUSE FOR MR. EDGAR J. KAUFMANN, PITTSBURGH, PA.
JANSSEN AND COCKEN, ARCHITECTS



SOME NEW WORK IN CALIFORNIA

BY KEM WEBER

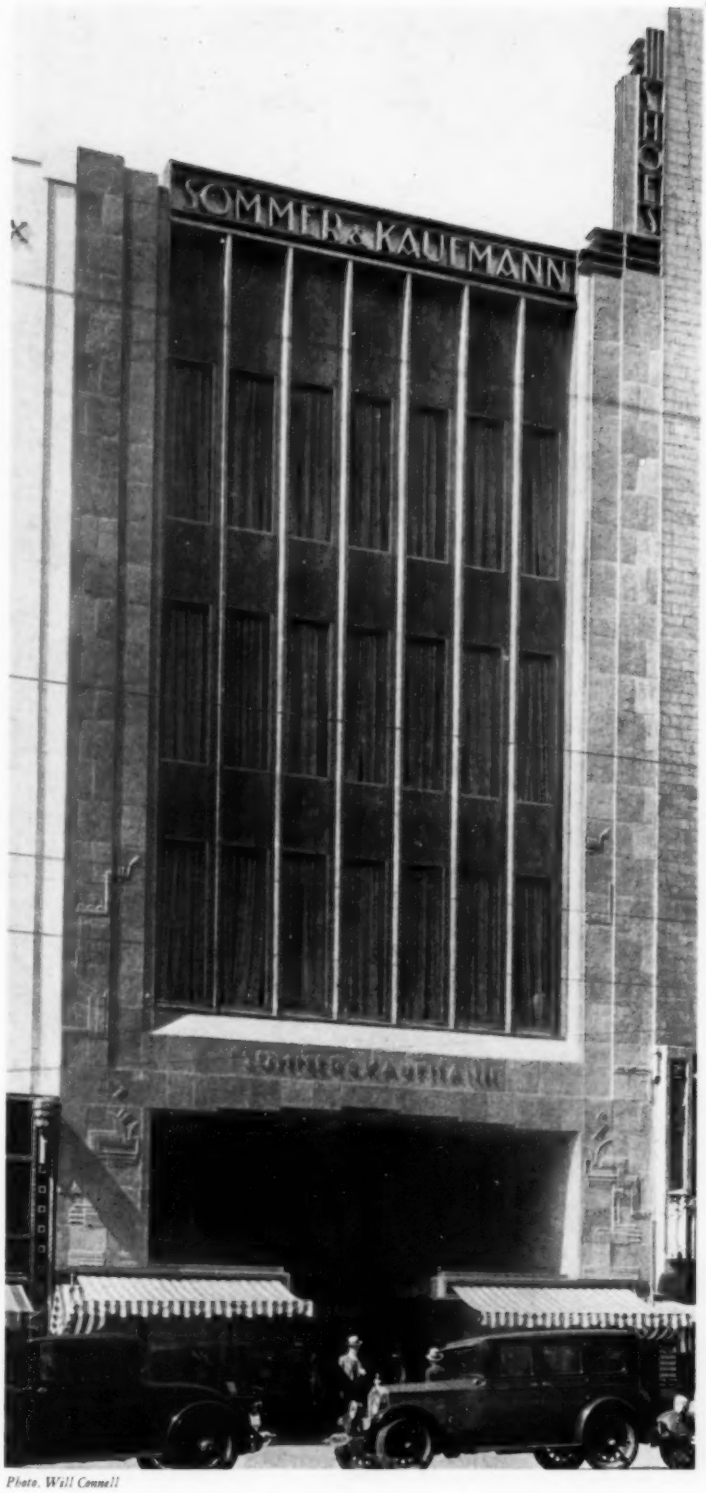


Photo. Will Connell

SOMMER AND KAUFMANN
SHOE STORE
SAN FRANCISCO, CALIFORNIA
KEM WEBER, DESIGNER

Market Street facade. Gray-green glazed terra cotta with Monel metal muntins and signs. Deep muntins however prevent good access of daylight. Imported Italian marble between windows. A steel hung opening for the main entrance is made to suggest masonry arch construction. Lettering above entrance is not easily read, whereas lettering at top of facade is not readily seen

Photo. Will Connell

SOMMER AND KAUFMANN SHOE STORE
SAN FRANCISCO, CALIFORNIA
KEM WEBER, DESIGNER

Entrance Lobby. Elevator doors of chased silver with small glass openings. Lighting fixture of sand-blasted glass and chromium-plated metal. Bas-reliefs by Eugene Maier Krieg

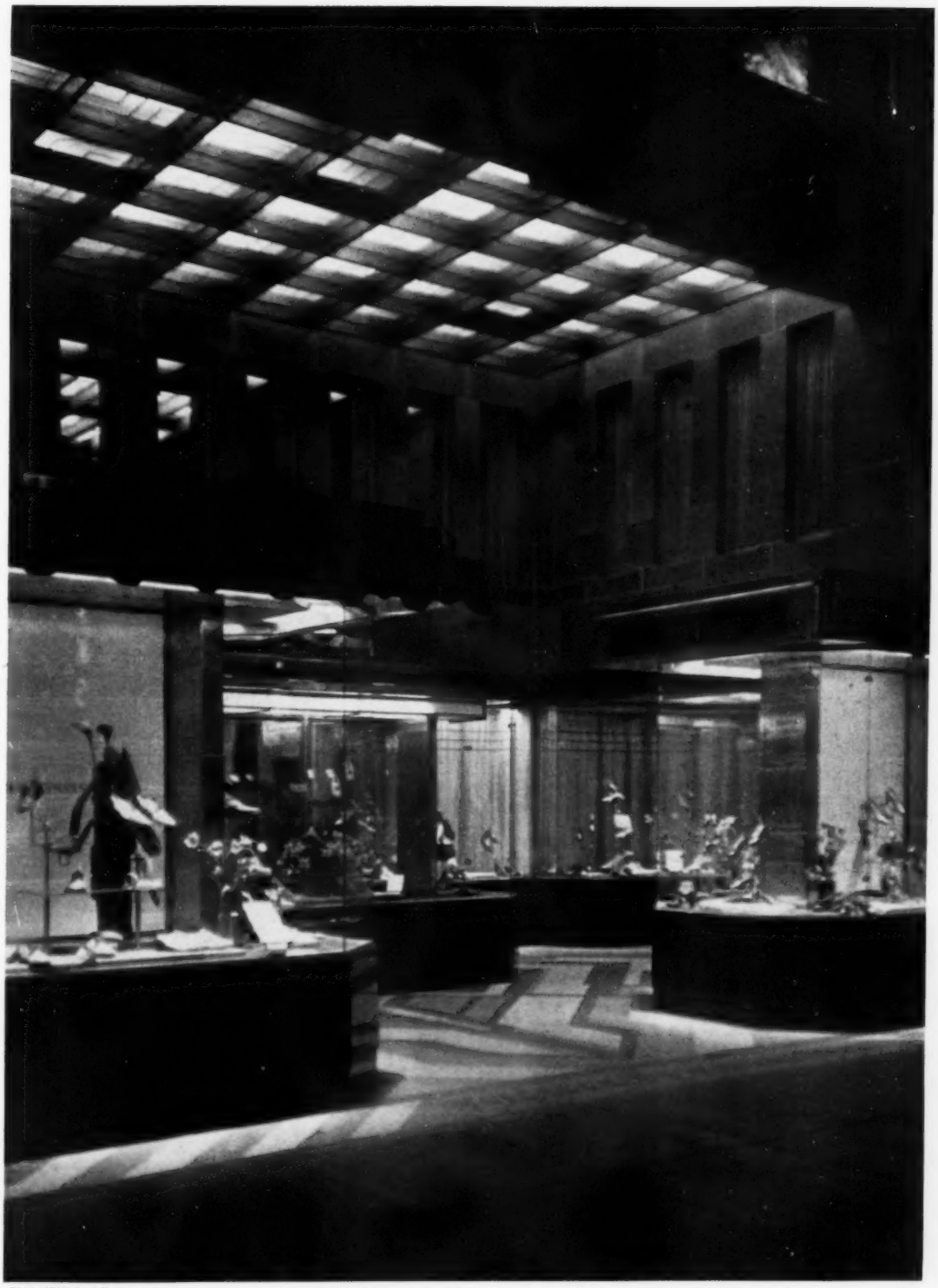


Photo. Will Connell

Vestibule with thirteen small display cases. Windows have bases of verdi antique marble and cornices of Monel metal. In ceiling soffit ribs of Monel metal and panels of sand-blasted glass.

SOMMER AND KAUFMANN
SHOE STORE
SAN FRANCISCO, CALIFORNIA
KEM WEBER, DESIGNER

Hosiery alcove in the main sales room. Furniture of American black walnut. Columns of Napoleon melange marble. Walls of varying shades of yellow stucco

Basement Plan

SOMMER AND KAUFMANN
SHOE STORE
SAN FRANCISCO, CALIFORNIA
KEM WEBER, DESIGNER

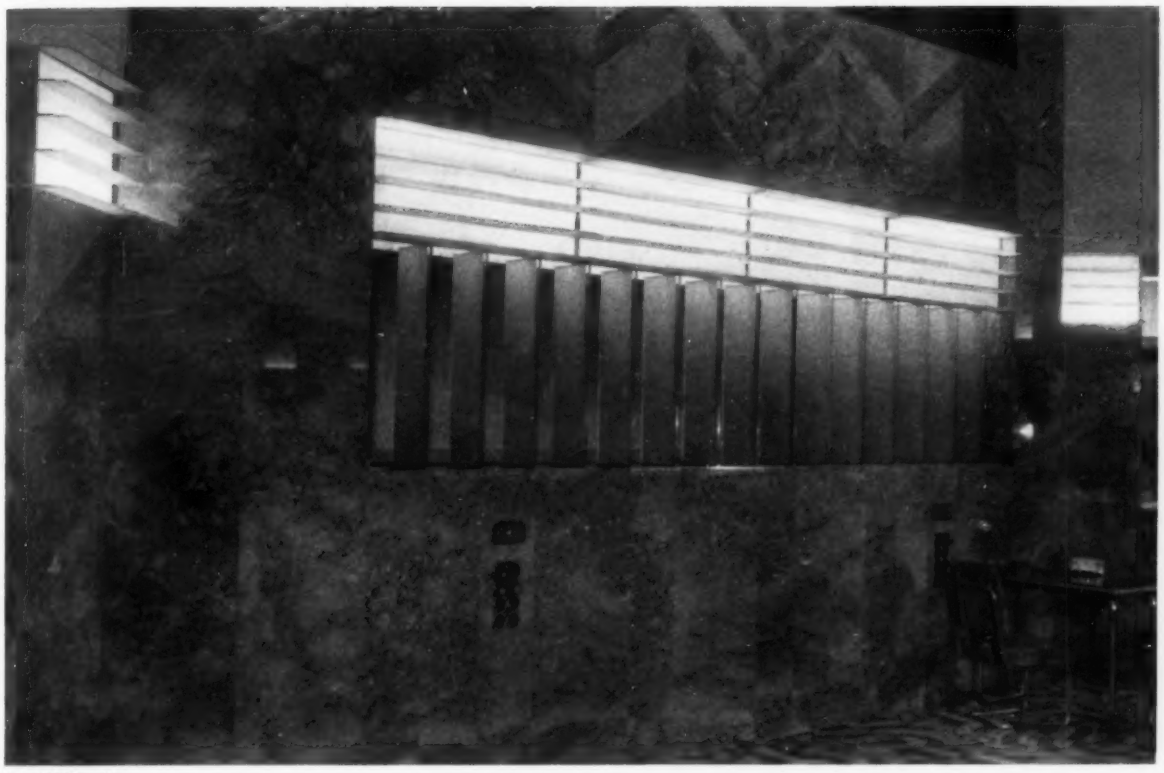
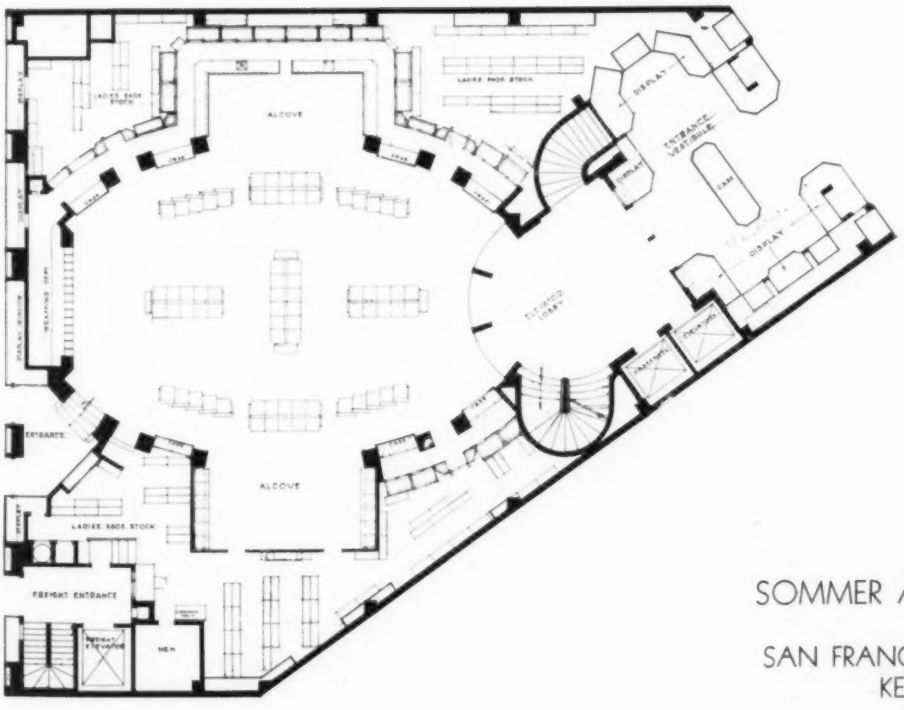


Photo. Will Connell

The wrapping counter is behind this marble wall at the end of the main sales room. The vertical louvres of ½-inch plate glass are so arranged that from any point in the room the salesman can see when his customer's package is ready. A good arrangement. Lamson tubes connect with the cashier and credit department

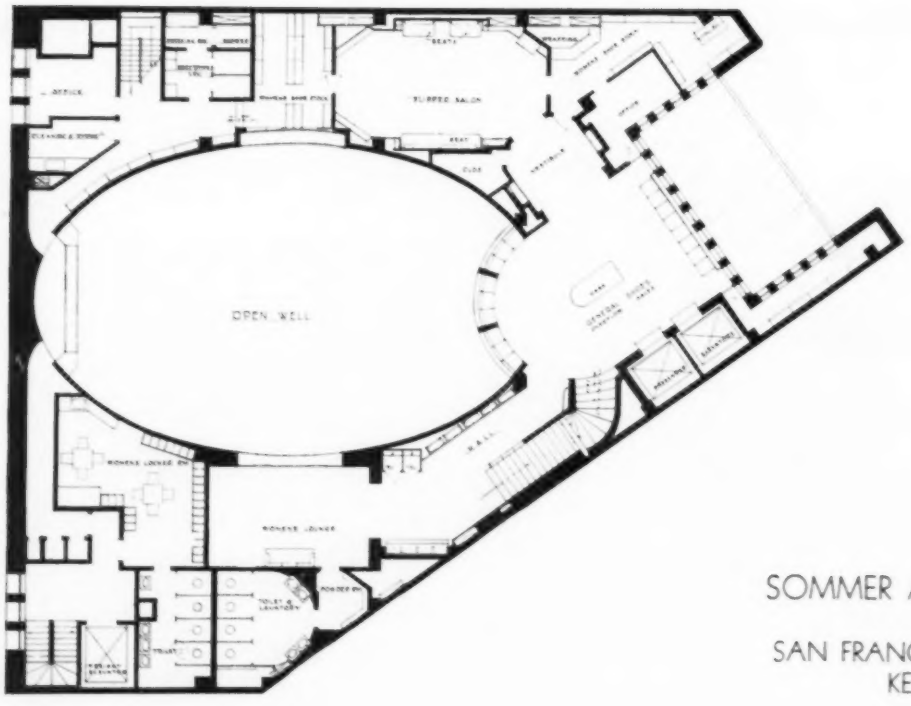


First Floor Plan

SOMMER AND KAUFMANN
SHOE STORE
SAN FRANCISCO, CALIFORNIA
KEM WEBER, DESIGNER

Photo, Will Connell

Detail of integral lighting for stairs on mezzanine floor



Mezzanine Floor Plan

SOMMER AND KAUFMANN
SHOE STORE
SAN FRANCISCO, CALIFORNIA
KEM WEBER, DESIGNER

Photo, Will Connell

Slipper room on the mezzanine floor where formal evening footwear is sold. Color scheme in green. Furniture of Macassar ebony upholstered in metallic fabric. Good straightforward lighting arrangement

Third Floor Plan

SOMMER AND KAUFMANN
SHOE STORE
SAN FRANCISCO, CALIFORNIA
KEM WEBER, DESIGNER

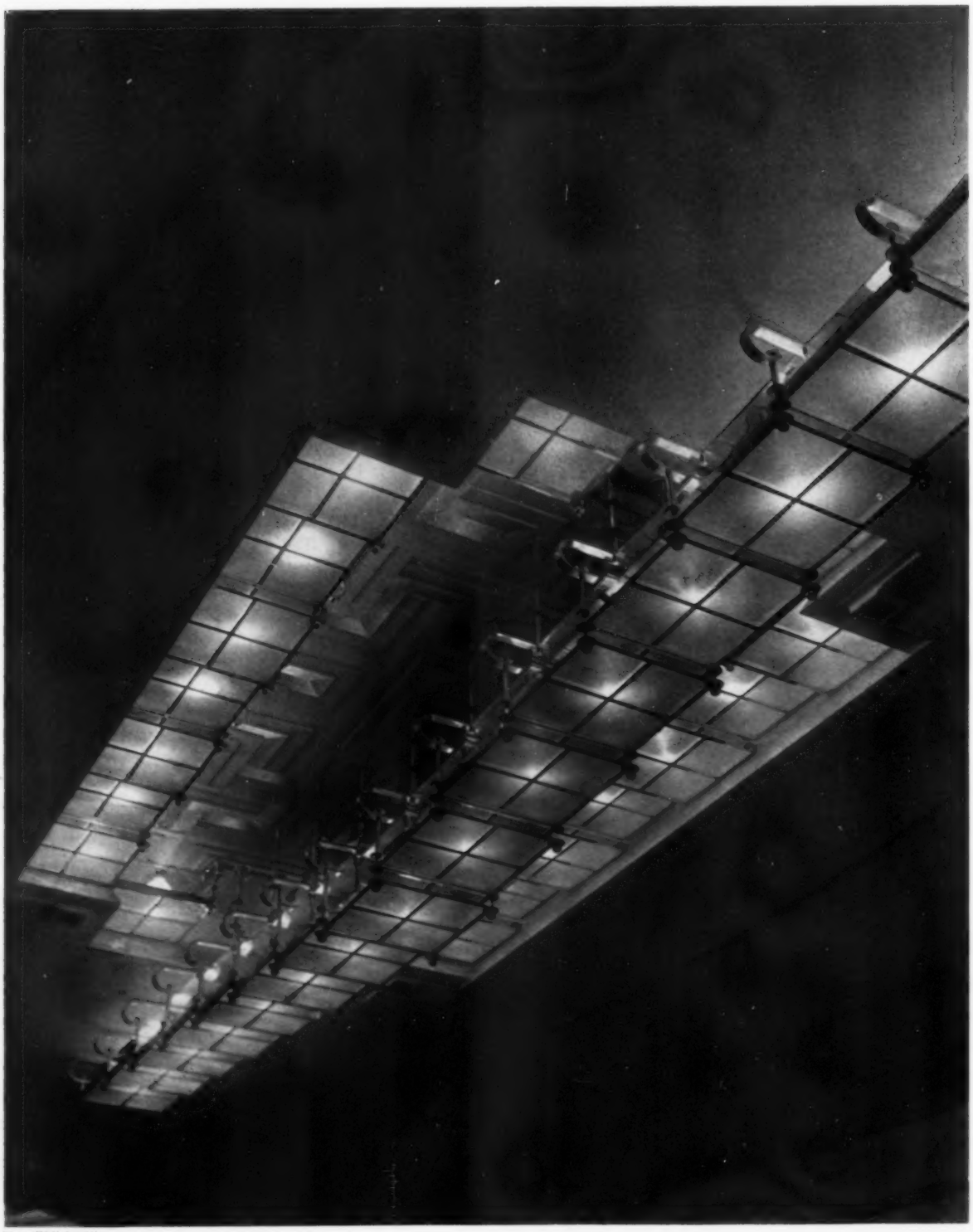


Photo. Will Connell

SOMMER AND KAUFMANN
SHOE STORE
SAN FRANCISCO, CALIFORNIA
KEM WEBER, DESIGNER

Detail of brass lighting fixture in main sales room, 13′ x 35′ and in two levels with center recessed. Designed to accommodate Holophane lens plates 12-inches square laid in groups of four

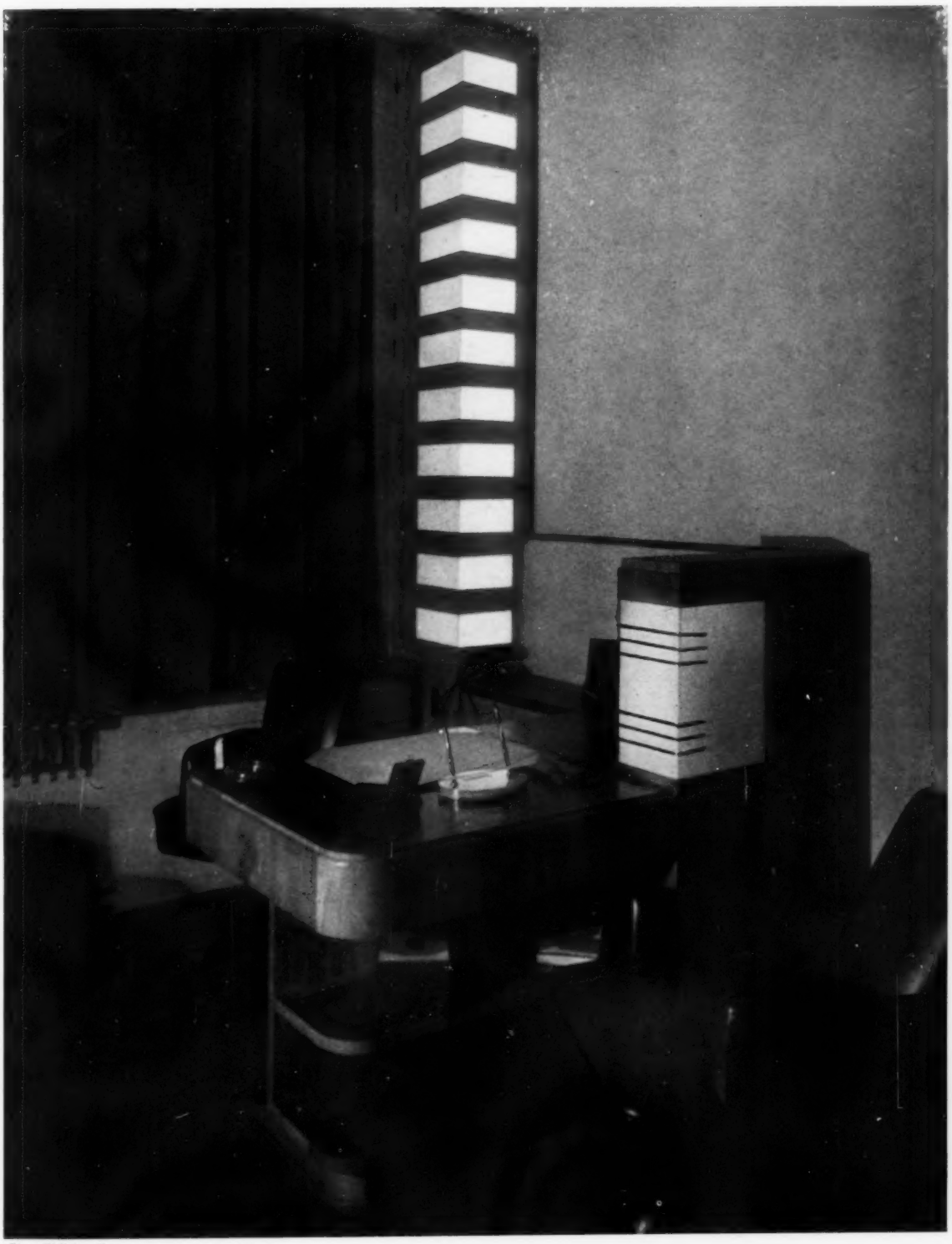


Photo. Will Connell

Private office of executive. Walls of cork tile and plaster. Desk of teak wood. Chairs in blue leather

SOMMER AND KAUFMANN
SHOE STORE
SAN FRANCISCO, CALIFORNIA
KEM WEBER, DESIGNER

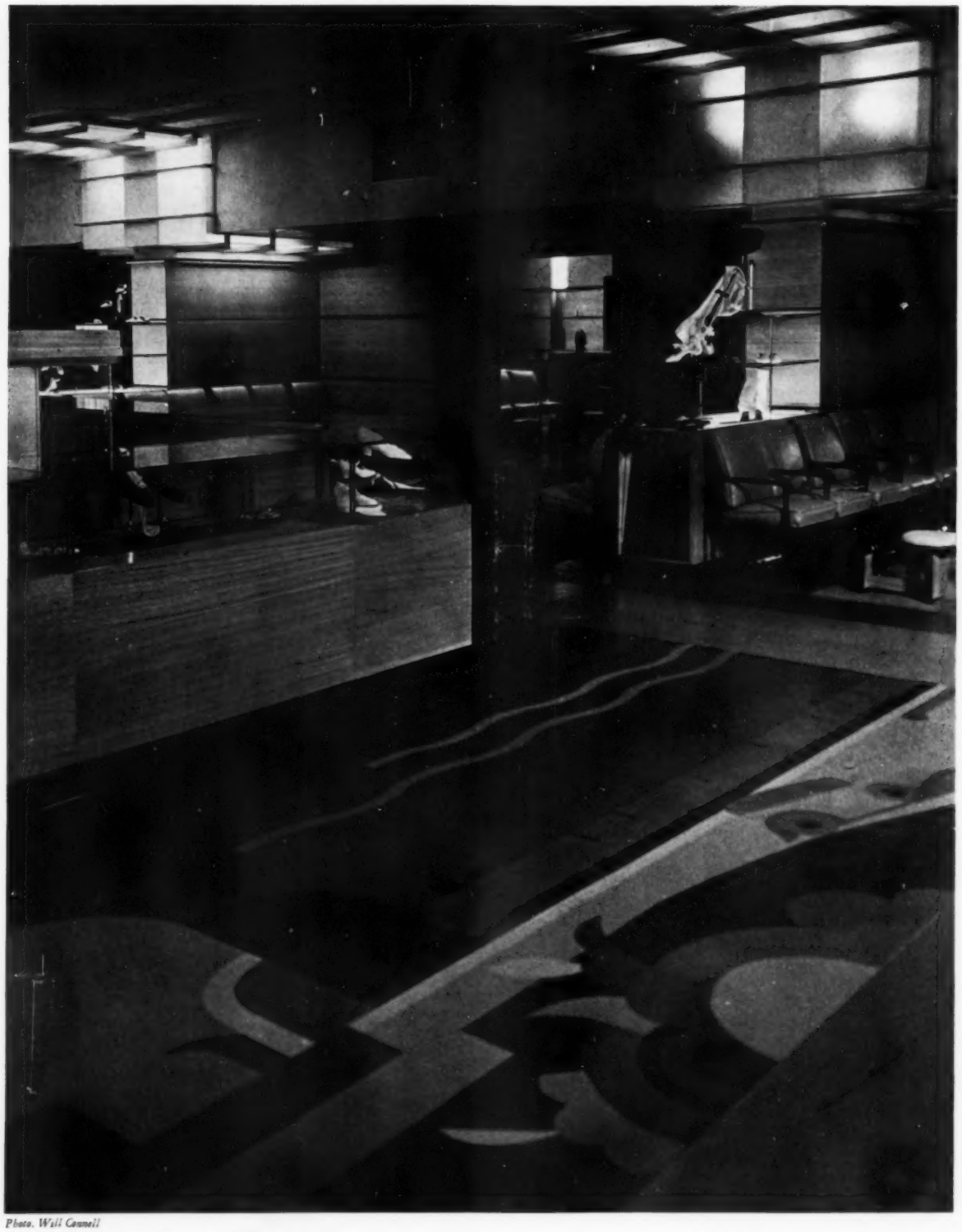
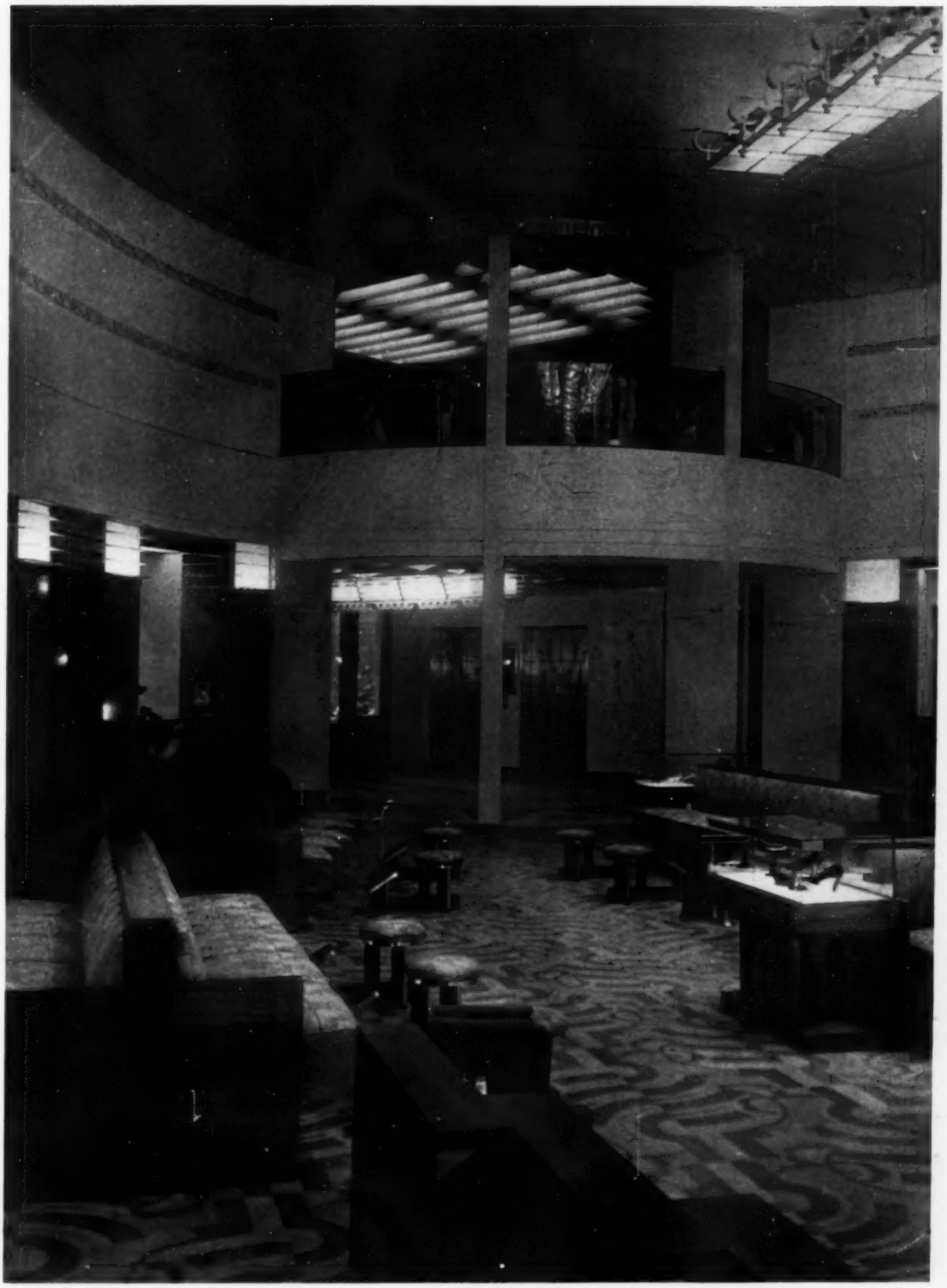


Photo. Will Connell

SOMMER AND KAUFMANN
SHOE STORE
SAN FRANCISCO, CALIFORNIA
KEM WEBER, DESIGNER

Children's department showing linoleum floor treatment



Photo, Will Connell

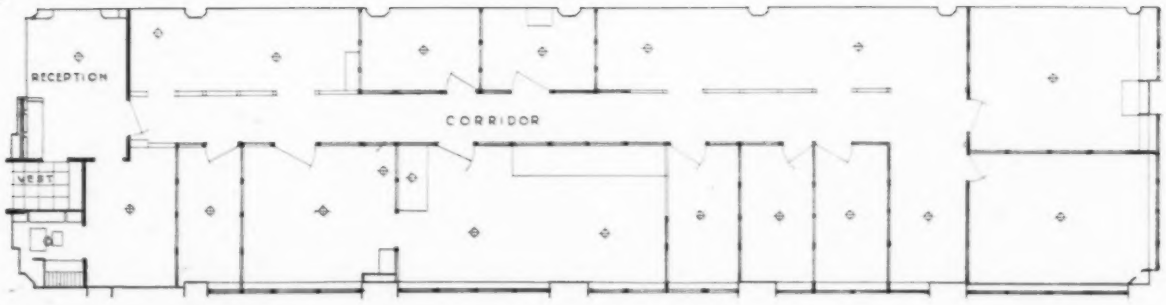
Main sales room with elevator lobby in rear. Gray Italian marble up to mezzanine floor level. Yellow dominating color in carpet

SOMMER AND KAUFMANN
SHOE STORE
SAN FRANCISCO, CALIFORNIA
KEM WEBER, DESIGNER

WORKING DRAWINGS AND PHOTOGRAPHS OF DETAILS

ADVERTISING OFFICES OF THE MAYERS COMPANY

LOS ANGELES, CALIFORNIA



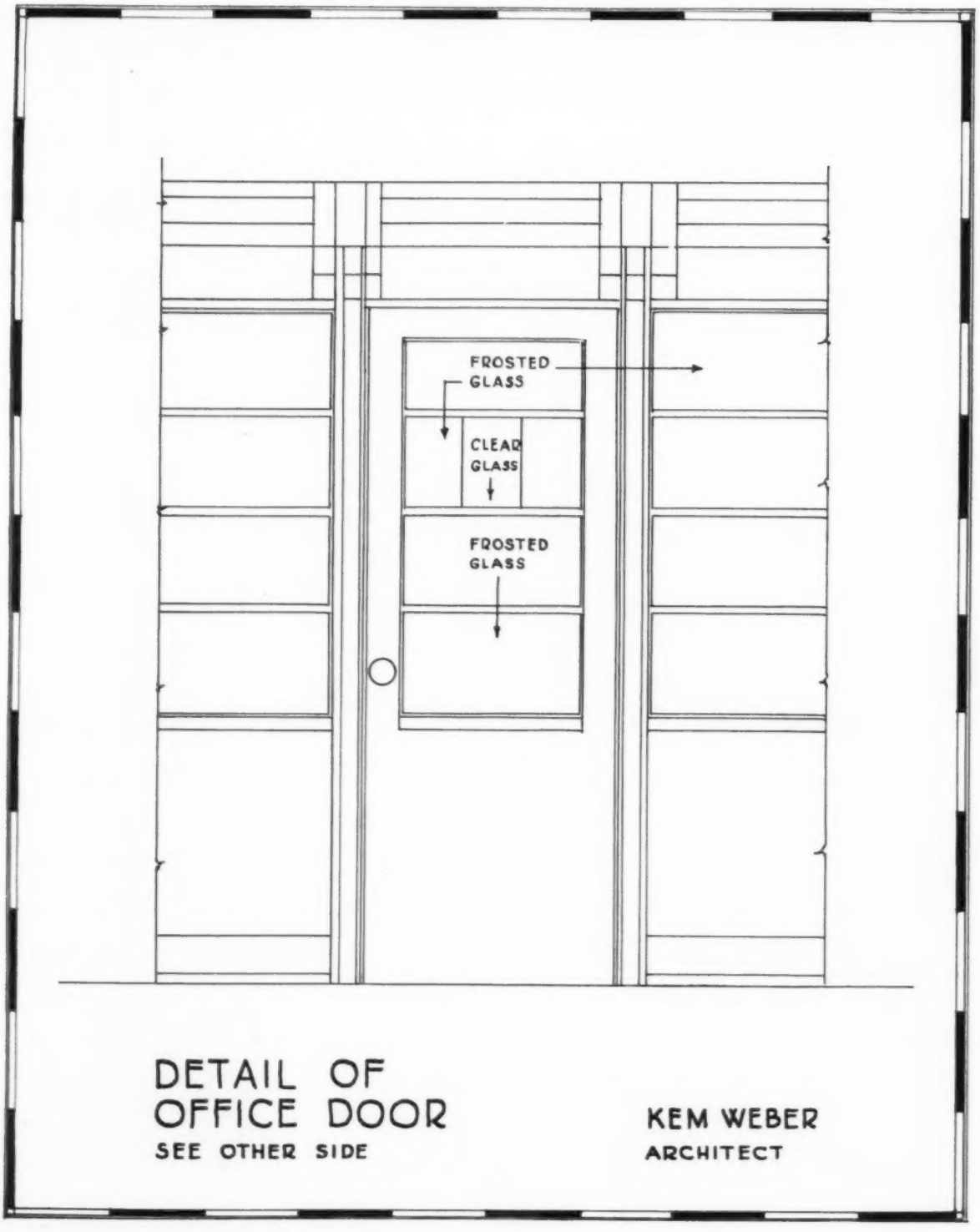
PLAN OF OFFICE LAYOUT

Remodeling Designed By Kem Weber

Photo, Willard D. Morgan

Each private office has a small unfrosted square of glass permitting one to look in without disturbing any special meeting or conference by opening the door

ADVERTISING OFFICES OF THE
MAYERS COMPANY, LOS ANGELES
KEM WEBER, DESIGNER



ADVERTISING OFFICES OF THE
MAYERS COMPANY, LOS ANGELES

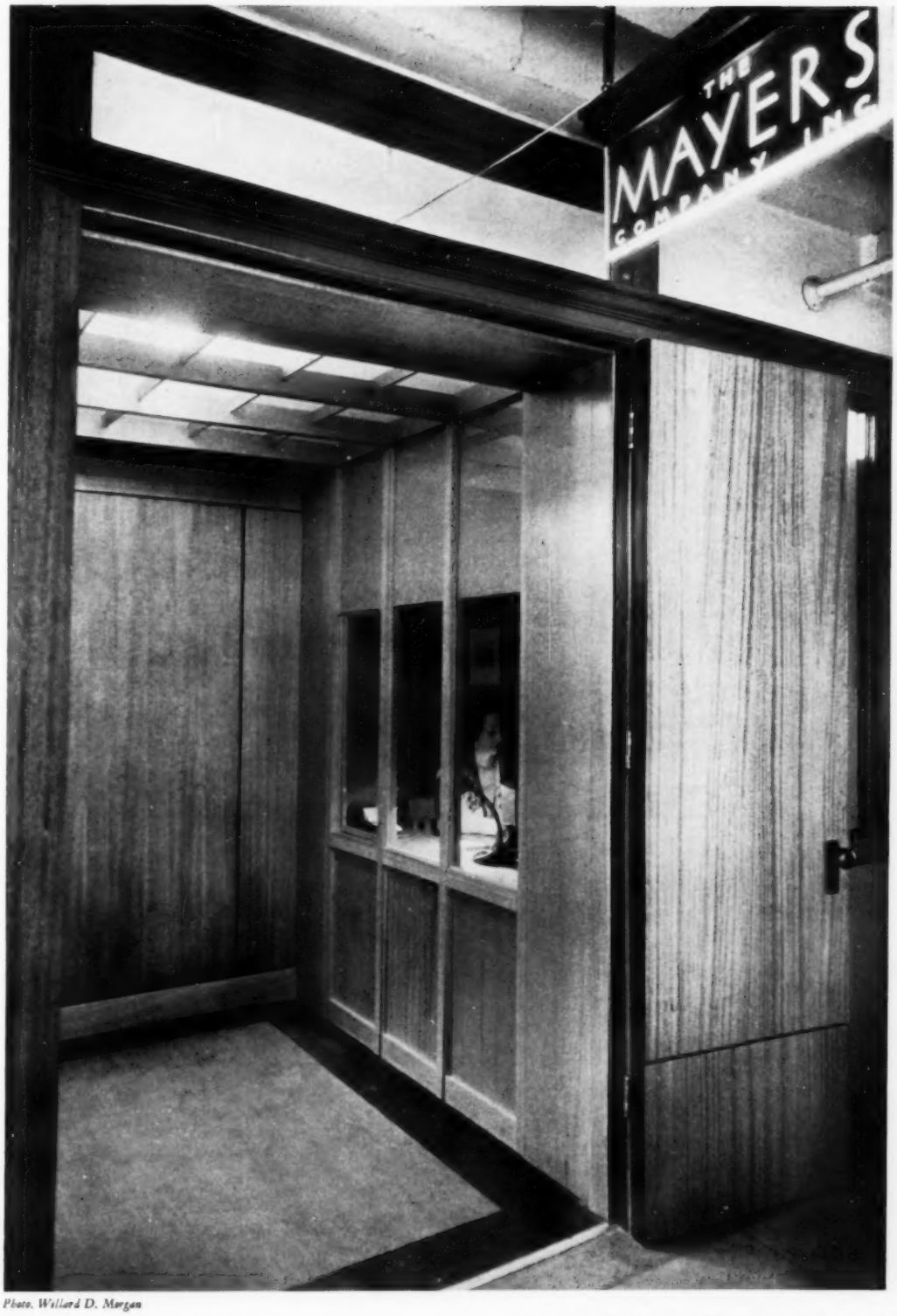
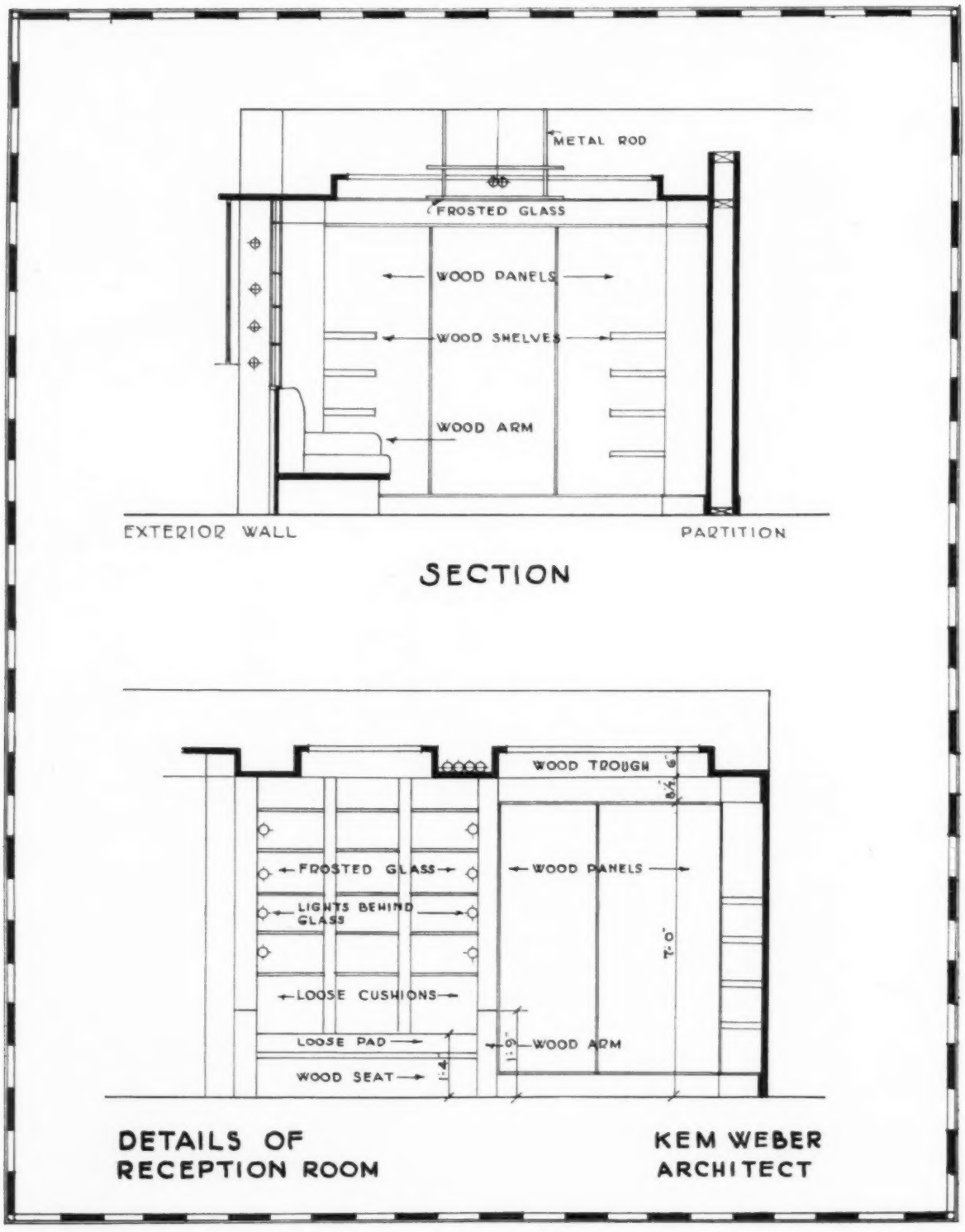


Photo. Willard D. Morgan

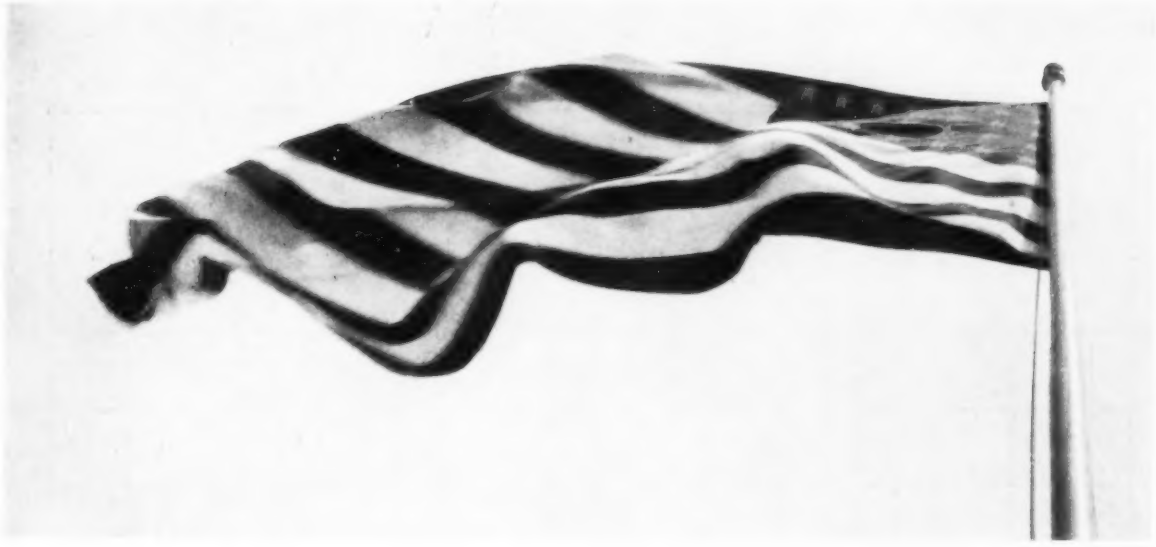
This entrance has a telephone booth at the right

ADVERTISING OFFICES OF THE MAYERS COMPANY, LOS ANGELES
KEM WEBER, DESIGNER



ADVERTISING OFFICES OF THE
MAYERS COMPANY, LOS ANGELES

NOTES ON DRAFTING AND DESIGN



THE DESIGN OF VERTICAL TUBULAR STEEL FLAGPOLES

BY S. J. WARBERG

The required strength of a flagpole at any point is governed by the more severe of two conditions:

(a) When a flag is flown from the pole, the strength required is governed by the size of the flag and the maximum velocity of the wind. This velocity may safely be assumed at 60 miles an hour, as a flag would be either pulled down before this velocity was attained or be torn to pieces.

(b) When no flag is flown from the pole, the strength required is governed by the maximum wind velocity recorded in the locality in question.

When these conditions are known, the pole may be designed for any height. The work is of a tedious cut-and-try character as the action of the wind on the pole itself accounts for a considerable portion of the governing bending moment, and indeed for high maximum wind velocities and the smaller sizes of flags may be the governing criteria above certain heights of poles.

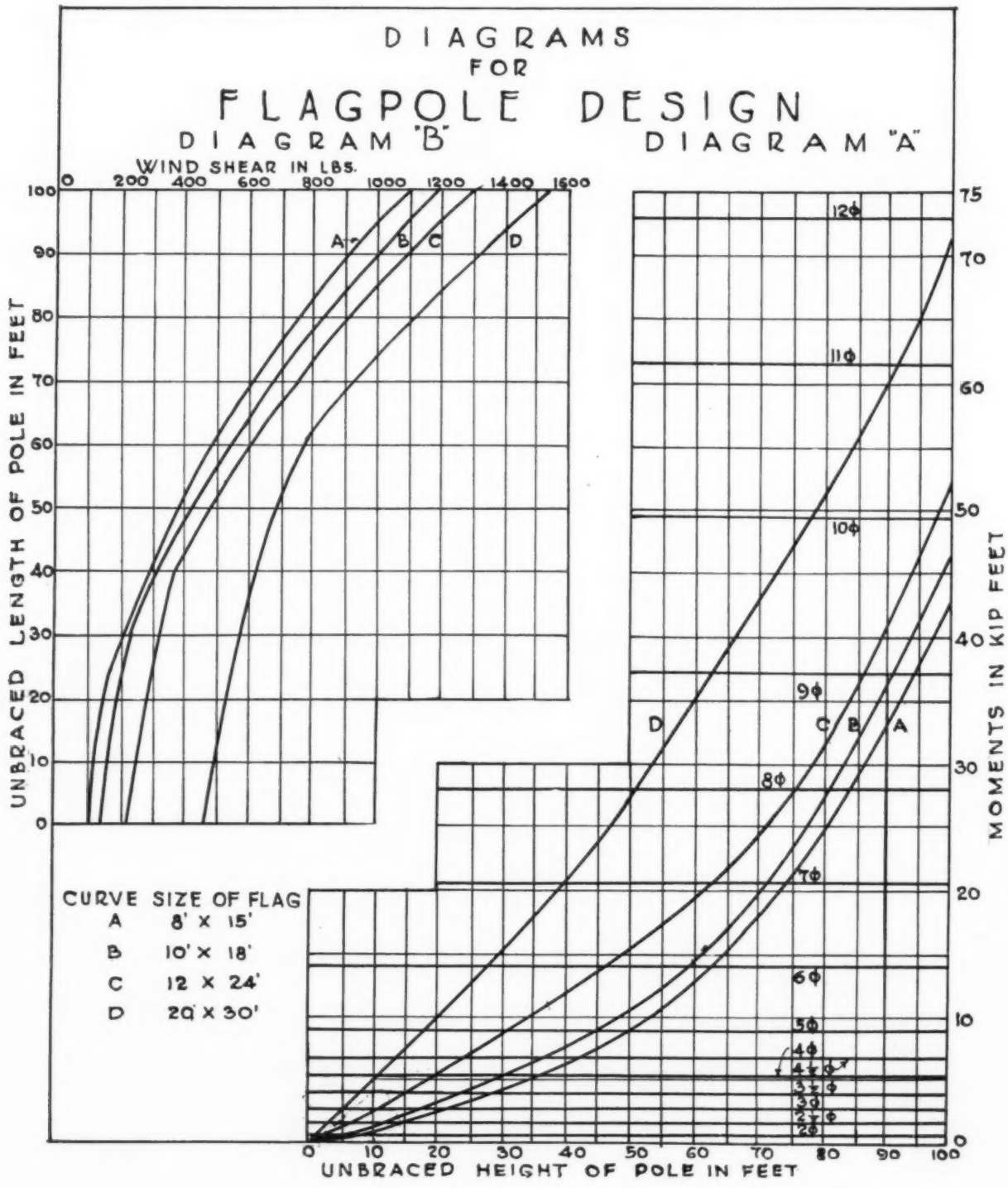
For the purpose of lightening this task, the writer has prepared curves giving bending moments and shears on four designs which are suggested as covering the most common requirements.

•

Certain manufacturers of tubular steel flagpoles follow the practice of placing a weaker section halfway down the pole to insure a failure where the least harm will result, in case of record-breaking wind storms. This would seem good practice.

The accompanying diagrams were worked out for conditions obtaining in Detroit and vicinity and for tubular steel poles with a maximum fibre stress of 20,000 pounds per square inch, as allowed by the City of Detroit Building Department.

The maximum observed actual wind velocity for this vicinity is 86 miles an hour. In the designs suggested, a maximum velocity of 90 miles an hour has been used on poles without flags. For poles with flags a velocity of 60 miles an hour has been used.



Inquiry revealed certain customs and usages with regard to **selection of sizes of flags** and height of poles, which are given below simply as a guide in selection:

(a) For school buildings, the following flag sizes are in common use: 5′ x 8′, 6′ x 10′, 6′ x 12′, and 8′ x 12′.

(b) For public buildings, the following sizes are used: 8′ x 15′, 9′ x 18′, 10′ x 18′, and 10′ x 20′.

(c) For tall office buildings, the flag sizes vary from 10′ x 15′ to 20′ x 30′, according to height of building.

All above flag sizes are known as "fair weather flags." In stormy weather, flags used are generally one-half these sizes.

The weather bureau, however, reports that a great many of the most violent wind storms recorded have come up during the early afternoons when "fair weather flags" were flying from the poles.

•

It would therefore hardly be advisable to design for any but fair weather sizes of flags, and this has been followed in the accompanying diagrams.

•

In general the height of pole is roughly proportioned to the size of the flag selected as follows:

On buildings not over five stories in height, the height of pole should be about three times the length of the flag. On buildings over five stories in height, the height of the pole should be about twice the length of the flag.

•

In calculating moments the pull of the flag on the pole was determined by the so-called "Navy Formula":

$$P = 0.0003\ A v^{1.9}$$ where

P = pull of flag on pole, in pounds, applied at top of flagpole,
A = area of flag in square feet,
v = velocity of wind in miles per hour, actual.

The pressure of wind on the pole itself was calculated by the formula:

$$P = 0.0025\ v^2\ d\ l$$, where

P = total wind pressure on a section of pole in pounds,
d = diameter of section in feet,
l = length of section in feet,
v = velocity of wind in miles per hour.

Diagram "A" gives maximum bending moments on four designs of poles A, B, C and D.

DESIGN

A is for flags up to and including 8′ x 15′
B is for flags up to and including 10′ x 18′
C is for flags up to and including 12′ x 24′
D is for flags up to and including 20′ x 30′

On all flagpoles, a finial was taken into consideration, consisting of a 12-inch diameter ball at 2 feet above top of flag. Height of poles is in all cases to top of flag.

Horizontal lines in Diagram "A" mark the resisting moments at a fibre stress of 20,000 pounds per square inch of standard steel pipe of the diameters given.

The designs are given in Table I, following page.

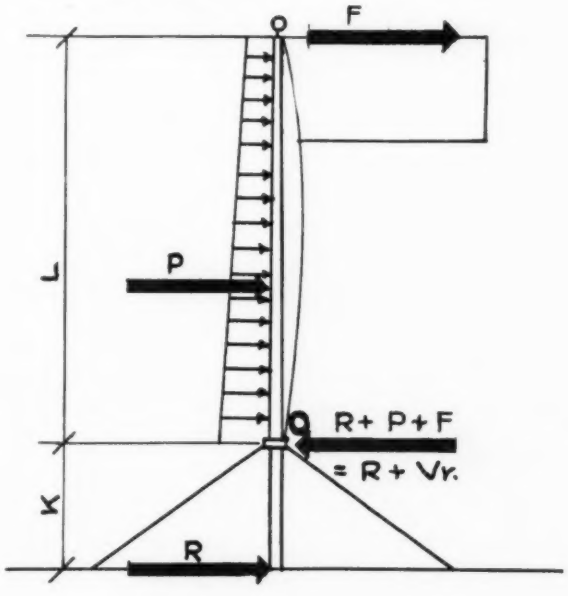


DIAGRAM "C"

TABLE I. PIPE SIZES FOR DESIGN OF FLAGPOLES

Size of Standard Pipe Inches	O. D. of Pipe Inches	Wt. per ft. of Pipe in lbs.	Length of Section in ft.			
			Pole Design "A"	Pole Design "B"	Pole Design "C"	Pole Design "D"
2"	2.375	3.652	6.5	6.0	....	....
2½"	2.875	5.793	5.0	4.5	....	....
3"	3.50	7.575	11.5	5.5	11.0	6.0
3½"	4.00	9.109	6.0	5.5	5.0	2.5
4"	4.50	10.790	6.0	5.5	5.0	3.0
4½"	5.00	12.538	6.5	6.0	5.0	....
5"	5.625	14.617	7.0	7.0	6.0	7.5
6"	6.625	18.974	13.5	13.5	14.0	9.5
7"	7.625	23.544	10.0	14.0	14.0	10.0
8"	8.625	28.554	10.5	13.5	14.0	11.5
9"	9.625	33.907	11.0	9.0	10.0	12.5
10"	10.75	40.483	12.0	12.0	12.0	15.0
11"	11.75	45.557	....	....	9.0	12.0
12"	12.75	49.562	....	....	....	11.0
Total Height of Poles in feet.....			105.5	102.0	105.0	100.5

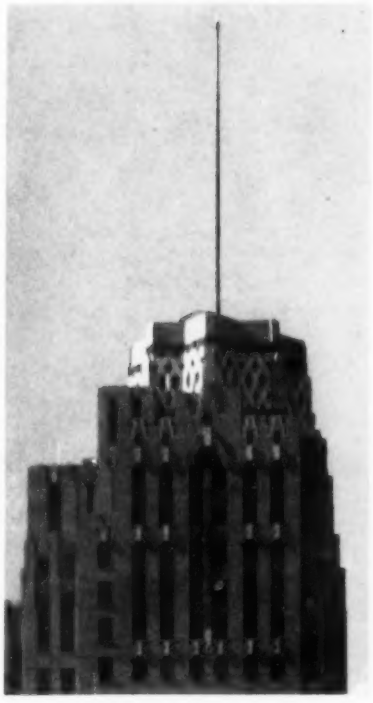
In practice it has been found that simply specifying "standard pipe" is not sufficient, as the contractor will almost invariably supply "standard gas pipe," which is much lighter and consequently weaker; the only safe way is to specify also the minimum total weight of the pole.

The pipe sizes given are *nominal* or approximate *inside* diameters of the pipe, but

EXAMPLE ILLUSTRATING USE OF TABLE I

As **an example** suppose a 60-foot pole is desired for a flag 10′ x 18′, or design "B". It is merely necessary to start at the *top* of design B and use sections from the top down, enough to give a total length of at least 60 feet; that is:

2" pipe 6′-0" + 2′-0" in telescoped joint wt. = 8 x 3.652 lbs. = 29.2 lbs.
2½" pipe 4′-6" + 2′-0" in telescoped joint wt. = 6.5 x 5.793 lbs. = 37.6 lbs.
3" pipe 5′-6" + 2′-0" in telescoped joint wt. = 7.5 x 7.575 lbs. = 56.8 lbs.
3½" pipe 5′-6" + 2′-0" in telescoped joint wt. = 7.5 x 9.109 lbs. = 68.3 lbs.
4" pipe 5′-6" + 2′-0" in telescoped joint wt. = 7.5 x 10.79 lbs. = 81.0 lbs.
4½" pipe 6′-0" + 2′-0" in telescoped joint wt. = 8.0 x 12.538 lbs. = 100.2 lbs.
5" pipe 7′-0" + 2′-0" in telescoped joint wt. = 9.0 x 14.617 lbs. = 127.3 lbs.
6" pipe 13′-6" + 2′-0" in telescoped joint wt. = 15.5 x 18.974 lbs. = 294.0 lbs.
7" pipe 6′-6" wt. = 6.5 x 23.544 lbs. = 153.0 lbs.
Total length = 60′-0" Total wt. of pole = 947.4 lbs.



FLAGPOLE ON UNION TRUST BUILDING
DETROIT, MICH.

the contractor is prone to assume this as the outside diameter (thus giving a weaker pole) unless the outside diameters are given on the detail.

•

Diagram B gives the total shears on these four designs which may be used in the design of the support of the poles as follows (see Diagram C):

Given: Size of flag and height of Pole = L.

K is determined by circumstances of location.

Then:

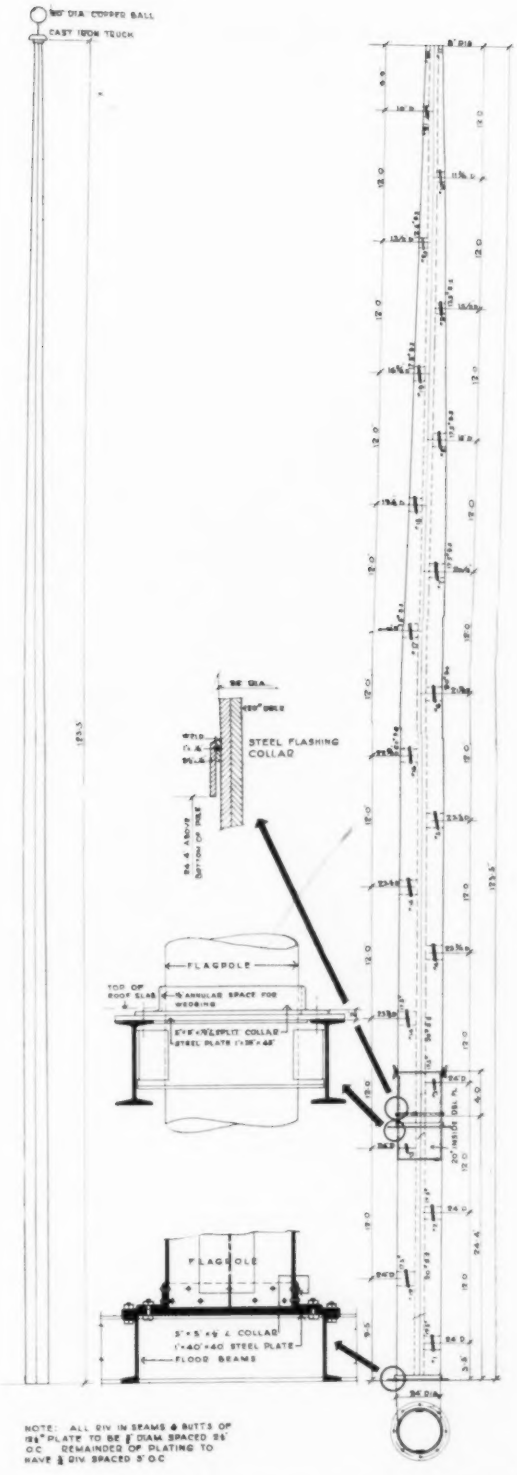
From Diagram "A", obtain Moment M_T for height L on nearest larger type of pole.

Moment at O is $M_T = K\ R$, from which

$$R = \frac{M_T}{K}$$

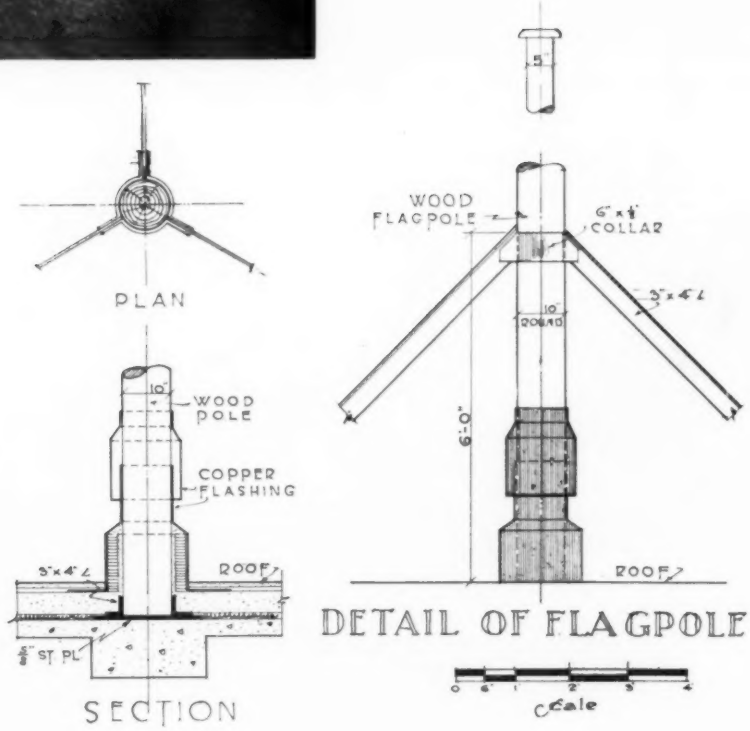
Maximum shear due to wind occurs just above O and may be obtained from Diagram "B" for height L and nearest larger type of pole. Let this be Vt.

With these quantities known, the design of the bracing support for the pole is simple.



DETAIL DRAWING OF FLAGPOLE ON UNION TRUST BUILDING
DETROIT, MICHIGAN
SMITH, HINCHMAN AND GRYLLS, ARCHITECTS AND ENGINEERS

FLAGPOLE ON TOWER
NEW YORK LIFE BUILDING



FLAGPOLE

The support and protection of a flagpole mounted on a roof top should be reduced to simplest construction. A pole up to forty feet may be of wood, preferably of clear spruce. Brace with single irons and flash base with copper

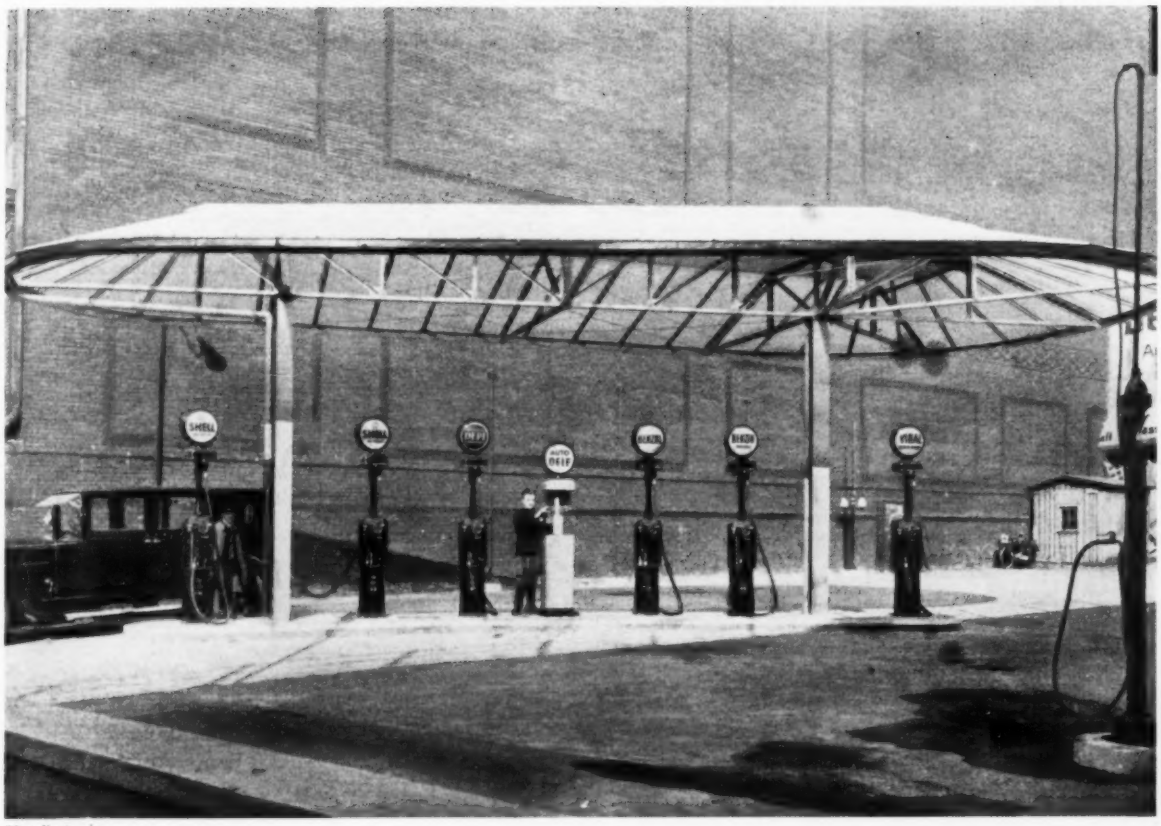
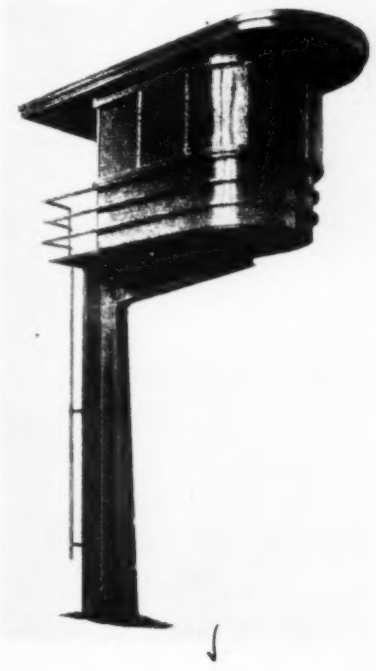
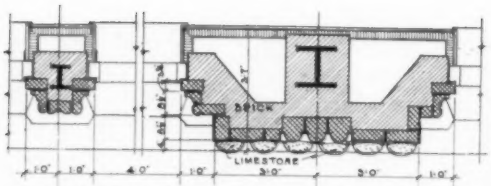


Photo Krajewsky

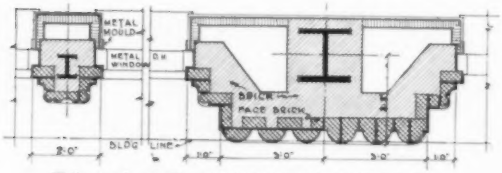
Filling Station in Berlin. Heinrich Kosina, Architect. Note the light construction of the canopy and the slender supports. See article: "The Gasoline Filling and Service Station" in the June Issue of THE ARCHITECTURAL RECORD



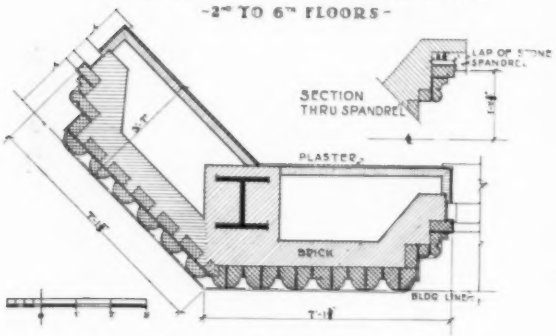
Traffic Tower, Berlin, Mies van der Rohe, Architect. The cantilevered support insures a minimum of obstruction to the street traffic



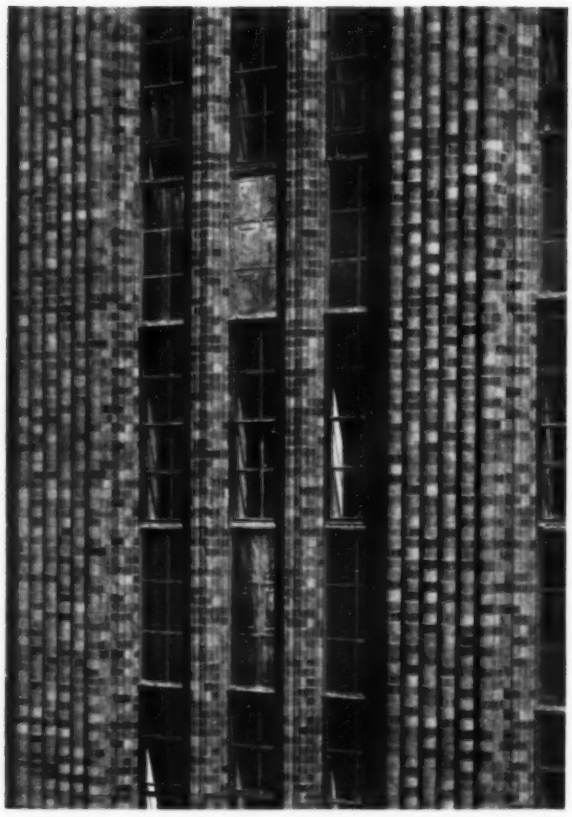
PLAN OF PIER ON 7TH FL.



PLAN OF MULLION & PIER
-2ND TO 6TH FLOORS-



PLAN OF CORNER PIER
-2ND TO 6TH FLOORS INCL.-



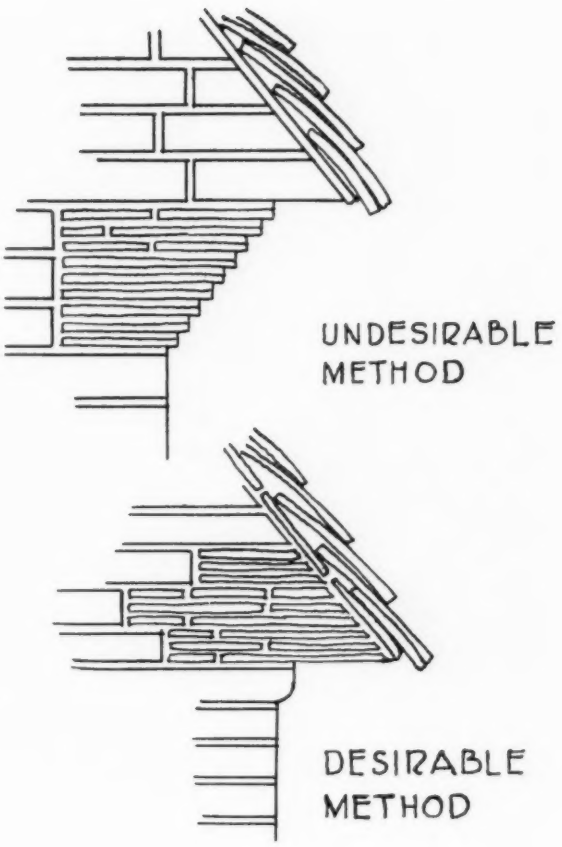
DETAILS OF BRICK PIERS AND MULLIONS
ABRAHAM AND STRAUS BUILDING, BROOKLYN
STARRETT AND VAN VLECK, ARCHITECTS

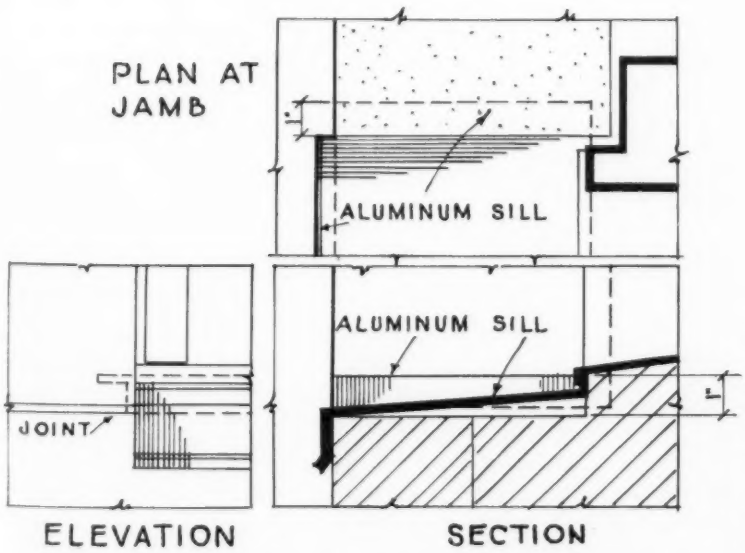
PARALLEL STRAIGHT-EDGE

Few draftsmen know that the parallel straight-edge attachment, now in general use, can easily be adjusted for drawing views or projections at an angle. Ordinarily, the draftsman does this work with triangles, which are not very accurate and which require more time than when working from a horizontal line. The parallel straight-edge can be pulled around to any angle from 1 to 30 deg. When this is done, the cord which extends along the top of the drawing board moves laterally. An indicating scale can easily be scribed on the board so that, when occasion arises to show a view at an inclination, the draftsman can pull the straight-edge around to the desired angle as determined by the scale and hold the cord in position with a thumbtack, working in the same manner as if from a horizontal line.—Morton Schwam, Philadelphia, Pa. From Engineering News-Record June 12, 1930.

GABLE ENDS WRONG AND RIGHT

Brick gable ends with corbelled tile for overhang may be detailed to eliminate wood crown mold. The flat tile should project the thickness of the end wall but not the brickwork. Heavy slate may be substituted for tile. (From the Architect's Journal, London, May 22, 1929)





DETAIL OF ALUMINUM SILL

WATERPROOFING SILLS

Sills may be of aluminum or stainless metal alloy, making stone or brick sills unnecessary. There are advantages to such construction as the sill may then be built integral with the sash and a more complete watertightness insured. Sills of extruded aluminum or alloy should be specified 3-16 inch thick, cast sills to be ¼ inch thick, with detail made by sash manufacturer

Photo. Underwood and Underwood

PLINY ROGERS

It is, perhaps, particularly fitting that I should write these few words in memory of Pliny Rogers, because he started his architectural work in our office some twenty-four years ago, when he came down from Cornell, and I think that with the exception of his immediate associates I was the last of the profession to see him.

We were building the Home Club on 44th Street in the fall of 1906 and were looking for a clerk of the works. Just how Pliny came to us I don't remember, but I do remember distinctly the very good impression he made in our first interview. He was a tall slender boy, rather reserved, with no practical experience, but very willing to try. It was a hard job for a beginner; a very complicated building, baths by the dozen, none over each other, as every floor had a different layout, and the owners had a way of going to Europe and cabling they had shifted their apartment from the fourth to the sixth floor, and they were most exacting in their demands. Pliny handled the situation well; saw to it that everything was done, and done right, and was most tactful in dealing with the clients. We have never had a better man. When the building was turned over he came in the office and I found, rather to my surprise, that he was an excellent draughtsman and had the makings of a good designer. He quickly picked up the manner of line drawing which I had learned from Bacon and Ross in the old McKim, Mead and White days, and became the best draughtsman we ever had. He left us after six years to go in with Mr. Litchfield and was for a time a member of the firm of Litchfield and Rogers, and practiced under his own name for the last four years. In partnership and alone he did much good work, a public library in St. Paul, a number of houses and apartments and an interesting development for the Government called Yorkship Village at Camden, New Jersey. His design was simple and restrained, thoroughly sound in every way; his knowledge of detail was profound, his taste uniformly good. And to the end he kept up his draughtsmanship; he made his own drawings mostly, and he took proper pleasure therein. I think, too, he had a good grasp of monumental work. I have several times urged him to go into competitions but he always seemed too busy in his other work to take the chance. If he had been stronger constitutionally I think he would have done it, and had he lived his proper span I have no doubt he would have made a great name for himself.

After he left us I saw little of him personally. Occasionally he would drop in and talk over some problem he had, or look at what we were doing. It was helpful to both of us. I only regret I did not see him oftener. He developed into a rather silent, reserved man, not assertive but fully able to hold his own with any one; not going out of his way to make friends but much esteemed by all with whom he came in contact; wrapped up in his profession and in his home; a fine man and a good architect.

EGERTON SWARTWOUT.

EDITORIALS

MAKE GRANDSTANDS SAFE

THE COLLAPSE OF GRANDSTANDS for school and college sports has been increasingly frequent since the war, according to the American Standards Association. The grandstand failures may be attributed to:

1. A desire to accommodate a large number of spectators in temporary grandstands at occasional sport events at a minimum cost.
2. Lack of regulations covering such structures.
3. The weakening of stands by repeated assembling and dismantling.

A large casualty insurance company has for ten years refused to insure grandstands of wood construction, and this naturally is the most common type of temporary stand.

In order to lessen, if not completely to eliminate, hazards to sport spectators, a national safety code is being prepared by engineers and experts in construction, under the guidance of the Standards Association. Architects concerned with athletic fields will wish to keep in touch with the recommendations of these engineers, which will be published in THE ARCHITECTURAL RECORD.

A. LAWRENCE KOCHER.

CRITICISM BY THE PUBLIC

FROM THE LAY CRITIC comes an increasing and lusty voicing of opinion on matters of design which will give, it is hoped, a healthy stimulus to the development of architecture. It is true that the more critical of the popular magazines, like the *New Republic*, the *Nation*, and the *American Mercury* with its articles by Lewis Mumford, have long been openly contemptuous of the tradition-bound products of the drafting room. The *New Yorker* has had its column by T-Square, privileged to comment on the various building activities of the metropolis. Occasionally a daily journal has been found criticizing in its editorial columns the prevailing architectural incongruities, and more recently *Life* and *Vanity Fair* have taken up the practice.

Now we find the interest of the layman extending beyond the completed building to the first published sketch. Culled from the press of the past month are two editorials, one appearing in *the new Freeman*, a liberal weekly, the other in the New York *Times*, both revealing the same skepticism.

Under the banner of "Form Follows Formula," *the new Freeman* article begins:

> On the same day last week, by a depressing coincidence, two important public building projects were announced, one to be carried out in the city of New York, the other in Washington, D. C. The designs furnished to the press establish the claim of the architects responsible for them to be congratulated upon their proficiency in archaeology. The design for New York was what Mr. Fiske Kimball might call a "superb restudy" of Kenilworth Castle. It will be a gift to the Metropolitan Museum of Art from Mr. John D. Rockefeller, Jr., and will rise above the Hudson in the superb park which Mr. Rockefeller has offered to the city. Since its purpose is to house the Museum's collection of Gothic art, a "restudy" of Kenilworth Castle will no doubt seem peculiarly appropriate to those who regard architecture as something to be borrowed from the past rather than created in the present. . . .
>
> The other design was Mr. Cass Gilbert's plan for the building which is to house the Supreme Court. It will stand opposite the Capitol, will be built in three years at a cost of $9,740,000, and is designed, we note with profound regret, to "last for all time." . . . For the Supreme Court Building he has chosen the Classic dress, Corinthian variant. There will be a middle section, with a portico at either end supported by Corinthian columns, which will quite effectually darken the interior. Flanking this will be two wings which will contain the offices of the Justices and the Court officials. The central portion of the building, which will house the Supreme Court Chamber and the main corridor, will, by a pretty conceit of the architect, "rise to a considerable height above the sections housing offices, as a means of symbolizing the relative importance of the various units." We had always thought that a work of art was in itself a symbol, and needed no associative symbolism to give it meaning. . . .

After labelling the Government buildings at Washington as being two-dimensional and dating back to the time when architects began to work from books, the article concludes:

> Mr. Gilbert's building will fit very well into this scheme of things, which is undoubtedly good enough for the Government architects, and probably good enough for the Government, but by no means good enough for America because it is not the best that American architects can do. And by the same token, neither is a restudy of Kenilworth Castle good enough—nor yet the imitation Classic design of the Memorial, lately approved, which is supposed to "embody the spirit of Theodore Roosevelt." For a country which had never produced any good buildings, an imitative, two-dimensional architecture might be condoned as better than nothing; but America is the country of the modern skyscraper. . . . of the modern factory-building, functional in design, austere and economical in detail; of the great elevators and other fine utilitarian structures which inspire admiration in foreign architects—who do not, by the way, visit this country to study the works of our archaeological school of architects, because they have plenty of these at home. . . . We regard it, therefore, as nothing short of a scandal and a national disgrace that important public buildings such as those we have mentioned are almost invariably turned over to architects whose originality is limited to choosing which of many antique models they shall copy, and whose relation to the present consists solely in the fact that they happen to live in it.

The *Times* editorial bears the caption of "Enduring Architecture" and also considers Mr. Gilbert's scheme for the Supreme Court building. Criticism of the design is by implication only; the discussion concerns the intended permanence of the structure:

> Not cheap ideals, then, but a definite philosophy, whether definitely realized or not, is behind the modern refusal to build for all time. . . . To raise buildings for all time is to impose ourselves on the future. It denies our posterity the right to express themselves in their own buildings in their own way. It fails to take cognizance of the speed of modern civilization, which in another fifty years may find skyscrapers for business offices giving way to the superior advantages of subterranean galleries electrically lighted and warmed by the new "fever tube."

Such a vigorous discussion of new buildings is to be welcomed. Far better for the architect and his building that the public should participate in its creation than that people should pass by, sublimely unconscious of defects and merits alike. In Europe controversies over projected buildings are quite customary not only among architects but also in the editorials and *vox populi* columns of the daily press. Ragnar Ostberg tells of the various attempts he made to design the tower for the Town Hall in Stockholm: several comparative solutions were evolved and published in the newspapers, and from the comments that followed the favorite was selected, revised and constructed in its final admirable form. More recently there has raged in the same city a schism between those who praise and those who dislike the functionally expressed buildings for the Swedish Exposition of 1930, designed by *Arkitekt* E. G. Asplund. Likewise in Holland and Germany one finds a keen public concern in what is happening architecturally. In these countries this popular interest is stimulated largely by the practice of the newspapers in employing professional critics to write frequent articles about new buildings in the same spirit in which the theatre critic reviews a new play.

Popular criticism of buildings is evidence of a growing demand for better structures. After all, since buildings are generally required to meet specific demands, it is for the architect to provide a solution that will satisfy these requirements. If he succeeds, the public which will use his building is best qualified to approve. If he fails and merely expresses his "soul" or "civilization" or any other convenient alibi, then also is it the public's privilege to condemn.

C. Theodore Larson.

TECHNICAL NEWS • AND RESEARCH

THE PROBLEM OF MAKING
BRICK WALLS
WATERTIGHT
Pages 77-86

THEATRE ACOUSTICS,
VENTILATING AND LIGHTING
Pages 87-96-101

NEXT MONTH:
WEEK-END HOUSES

THE PROBLEM OF MAKING BRICK WALLS WATERTIGHT

BY STANLEY NEWMAN

*"One of the most important problems facing the building industry of today is probably that of leaking brick walls. The recent expenditure of over one hundred thousand dollars in trying to make a single building in New York City tight against rain gives some indication of the seriousness of the situation."**

POROSITY OF THE UNIT

The common conception is that the units composing a leaky wall are so porous that water passes through them. It is probable that less than five per cent of the trouble is from this source. Leaks are caused by a lack of continuity in the exposed surface or skin of the building. Water penetrates to the inside of the wall through cracks and holes and not through pores. If the problem were one of porosity, it would be a simple matter to seal the pores with a waterproof treatment. In our twelve years of experience we have never attempted to stop the entrance of water by the use of any such treatment alone. Pores can be waterproofed, but not holes or cracks.

The internal ventilation or "breathing" of a masonry wall not only assists in the process of drying after partial saturation, but increases its life, and it is therefore important that the units be of sufficient porosity to permit the air, under normal conditions, to take care of the moisture in the wall. Other things being equal, walls of medium porosity withstand the elements for a longer period than those of very low porosity, as a dense masonry dries more slowly. It is also well to remember that masonry units taking up moisture rapidly give it off rapidly; units absorbing moisture slowly give it off slowly. A dense wall is more affected by frost when subject to a sudden drop in temperature, as it contains more water in proportion to the porosity.

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WORKMANSHIP

Good workmanship involves a thorough filling of all bed and end joints with sufficient mortar and the proper placing of the masonry units. These are the chief duties of the bricklayer. Yet where workmanship has been the cause of leaking walls, it has been due in most cases to lack of sufficient mortar in the end joints. The bed joints are usually fairly well filled, as it would otherwise be difficult to lay a stable and presentable wall. Since the joints constitute the most vulnerable portion of the surface, it must be borne in mind that a perfect bond between the brick and the mortar is most essential.

For all exposed walls subjected to wind-driven rain, the outside courses should be laid with shoved joints formed with a bed of mortar, a little thicker than the finished joint, by pressing the brick, or other unit, downward and sideways with sufficient strength to force the mortar into the end joints. Furthermore, additional mortar should be placed in the upper part of the end joint, and sufficient pressure exerted to force it out the full depth of the joint. In the backing, whether of brick or tile, a partial separation, or break in continuity, creating air spaces, is considered to make the wall more weather-resisting; it will dry out more quickly and is amply strong for ordinary loads. Porous back-up units reduce the chances of water reaching the inside of the building.

The real resistance of any wall, however, is found in the exterior course of masonry, and if the joints are all well filled—both bed and vertical joints—and a proper adhesion obtained between the mortar and the contiguous units, there need be no fear of leaks. It is very difficult to get masons to lay shoved joints, for a man's hand will be raw and tender if he is forced to shove all joints the entire day. Consequently, by eliminating this requirement in the back-up courses, there is a better assurance that the mason will shove all the joints in the veneer or exterior course. Neither is there any reason to believe that this practice will reduce the resistance of the wall.

The general specification that all masonry units should be wet before laying, except in freezing weather, is an essential requirement, provided that it is not indiscriminately applied to units that are dense and impervious. The hotter and drier the weather, the more water should be used. If porous materials are not wet, they absorb the moisture from the mortar, leaving an insufficient quantity for the proper hydration of the cement and lessening or destroying the bond between the mortar and the unit.

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*Statement of F. O. Anderegg, conducting an investigation for the Eastern Face Brick Manufacturers' Association in cooperation with the Portland Cement Industrial Fellowship of Mellon Institute to determine the causes of, cures for, and prevention of leaky brick walls. *Journal of the American Ceramic Society*, Columbus, Ohio, May, 1930, page 315.

Many leaks are traceable to this source, and there is very little danger from porous brick being laid too wet, but as the wetting of the brick takes labor and makes it harder on the hands of the mason, wetting is often neglected, unless insisted upon by the builder. On the other hand, the units should not be soaked to the extent that they slide on the mortar bed, or carry an excess of surface water which will thin the mortar so that it may run down the face of the wall. Over-wetting also eliminates the proper suction necessary to draw the mortar into the pores of the brick and diminishes the bond between the mortar and the masonry; there is also danger that soluble salts in the brick may be dissolved and later brought to the surface where subsequent evaporation will cause efflorescence. A brick of low porosity should be immersed in water and immediately removed.

In cold weather the rate of absorption is lowered, and it is desirable to use a brick or other units of higher "sucking power." The width of joint should also be considered; a more porous brick being preferable when a wide joint is desired. Thin joints of one-quarter inch or less, when the work is done in hot dry weather, require a unit having an absorption rate of from one to four per cent in two minutes of immersion. In cold damp weather these values might well be doubled. For thick joints this rate should be doubled for summer work and quadrupled for winter work. The above recommendations are based upon the work of F. O. Anderegg at Mellon Institute, University of Pittsburgh, who was assisted by skilled mechanics. These results have also been checked by careful observation on a number of jobs.

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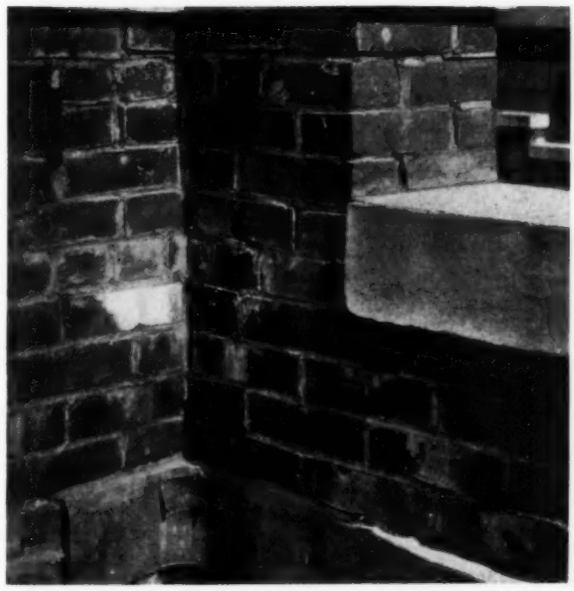
THE MORTAR JOINT

As the total joints in brickwork constitute approximately one-seventh of the wall volume, it is evident that the type of joint plays an important part in the elimination of leaks in masonry. There are many cases on record where every detail was correctly specified and executed with the exception of the manner in which the joints were constructed, and this one feature caused leaking of the wall.

Cut-flush and raked joints, while they may improve the appearance of a wall surface by adding color and texture, are so difficult to properly construct that we recommend their elimination for buildings accessible to wind-driven rain. It has been our experience that in forming cut-flush and raked joints the tendency is to open up the body of the mortar and to draw the mortar away from the units.

The joints that afford the best protection are those of the weathered and concave type. These not only present an excellent surface for the shedding of water, but require for their formation an amount of pressure sufficient to compress the mortar and create a firm bond between the mortar and the brick at the face of the wall, thereby reducing the probability of hidden cavities.



Cracks in Parapet Caused by Improper Mortar and Insecure Bonding of Brick and Mortar

The size of the joint also is an important factor; wide joints cause considerably more trouble than narrow joints, due to the sagging of the mortar.

Many architects, for the sake of appearance, specify a mortar joint with a thickness of one-half or three-quarters of an inch; the latter has just three times as much shrinkage as one a quarter of an inch thick. Another disadvantage of a wide joint is that it is necessary to use a very dry mix, as the least amount of excess water causes a "bleeding" of the mortar. On the other hand, too dry a mix lacks sufficient moisture to hydrate the cement.

Other things being equal, the thinner the mortar joint, the stronger the masonry and the greater the resistance to the infiltration of water. Of course there is a limit to the thinness of the joint, but as long as there is sufficient mortar between the brick to fill all cavities and to bond the units, the purpose of the mortar is accomplished.

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THE MORTAR

Next in importance to the quality of the units that make up a masonry wall is the character of the mortar, or cementitious materials, which serve to bind these units together. The first masonry walls were brought together and properly placed without the use of a binder or mortar. One of the first binding materials to be used was lime. Today the practice on most operations is to use hydrated lime; this material has the advantage over quicklime that it

does not require slaking before being mixed with the cement and sand. The choice between the two types of lime is a matter of cost as excellent work can be done with either. In general it is a good plan to use a higher proportion of lime when laying brick having a comparatively high absorption. Every mason realizes however that the proper amount of lime added to Portland cement mortar increases its workability and causes the mortar to spread more readily.

It is doubtful if mortar is ever mixed for too long a period. On most operations a careful inspection will disclose a lack of homogeneity in the mixture. This condition can be so easily controlled and is so detrimental to the work that it would seem to be inexcusable. If masons could be made to realize the advantages in workability and future imperviousness to be gained by thorough mixing, there would be much less leakage through masonry joints. The present practice is to mix from one to two minutes. The latter should be an absolute minimum and some day it will be realized that the mixing period might be considerably extended. In fact we are told that some engineers recommend that the mortar be mixed for at least one and one-half hours.

Experience would indicate that most leaks are due to lack of resistance in the mortar joint. The following properties are necessary to insure proper resistance, assuming that the workmanship is good:

1. Plasticity—the quality of workability under the trowel.
2. Impermeability—the mortar must be of a suitable structure, when hardened, to resist the passage of water.
3. Adhesion—the ability to bond properly to the units.
4. Elasticity—the ability to resist stresses due to temperature, slight settlement and wind, without appreciable cracking.
5. Minimum shrinkage in the final setting of the mortar.

Besides the amount of water used in the mix the three chief factors determining the character of the mortar are: the cementing material, the aggregate, and the ratio between the two. The thoroughness of mixing is also important.

The ideal mortar should have both cohesive strength and bonding quality. Mortars containing a relatively large amount of cement suffer greater volumetric changes during hardening than the weaker mixtures. Wet mixtures suffer greater changes than those of drier consistency. In other words, mortar containing an excessive amount of cement or water, or both, shows a proportionately greater amount of shrinkage which tends to destroy the bond between the mortar and the masonry units.

The Portland Cement Association formerly made the following recommendations: "A proportion of one sack of cement to two cubic feet of sand will be found satisfactory under most conditions. A mixture containing in excess of three cubic feet of sand for each sack of cement is not recommended. Hydrated or slaked lime may be added to the mortar in an amount not exceeding 25 per cent by volume of the amount of cement in the mixture."

The new recommendations of the Portland Cement Association reduce the amount of cement and increase the amount of lime, and in a recent letter from the Association one part cement, one part lime and six parts of properly graded sand are now recommended.

Approximately these proportions have been successfully used by the foremost builders of industrial chimneys constructed of radial brick; the resulting mixture has a satisfactory plasticity and bonds well with the units.

It is interesting to note that cement mortar of average consistency has a much greater expansion than that of ordinary brick. A rich mortar of high cement content will give a greater initial shrinkage and less adhesion than one containing a lower amount of cement. It is the practice of many architects and engineers to specify a mortar of one part cement and three parts of sand with approximately ten to twenty-five per cent of hydrated lime.

With the greatly increased use of Portland cement during the last twenty-five years, there has been a radical change in mortar mixtures from lime mortar to cement-lime mortar; fire resistant buildings with bearing walls required mortar of sufficient strength to carry the superimposed weights; rich mixtures were used. Today most fire resistant construction is supported by structural steel frames, and it is not necessary to use such a high proportion of cement in the mortar.

J. W. McBurney in "The Effect of Strength of Brick on Compressive Strength of Brick Masonry," Proceedings of the American Society for Testing Materials, Vol. 28, page 605, states:

"Except where lime mortar was used, the typical failure of brick masonry at maximum load was by crushing of brick. Mortar 1: 1: 6 (one part Portland cement, to one part lime, to six parts sand) or stronger, was apparently uninjured."

According to this statement, it would seem that except for bearing walls the general practice is to use a larger proportion of cement than required for the purpose of strength. It should be remembered however that where bearing capacity is required, it is desirable to use a mortar of comparatively high Portland cement content, as the strength of masonry is closely associated with the strength of the mortar comprising the joints regardless of whether the mortar or the brick is stronger.

SAND

The old standard specification that the sand shall be sharp and clean should be changed to require a clean, well-graded sand with particles ranging from fine to coarse. The use of very fine sands should be discouraged and the size of the coarser particles should be as great as the width of joint permits.

The inspection of a leaking building, made several weeks ago, showed that a poor sand was the primary cause of the trouble. The material was too fine and contained a high percentage of loam, resulting in a weak and porous mortar. The porosity of the masonry units provided sufficient suction of the mortar and the proportion of sand to cement appeared satisfactory, but the mortar was so soft that it could be dug away with the fingernails. In this particular building the water was penetrating through the entire mortar joint and not confining its entrance to any shrinkage cracks between the mortar and the brick. The workmanship was of average quality and we feel that the whole trouble in this case was due to the sand. Even if money was saved by the purchase of this material, it was offset in labor, as the substitution of a cleaner, coarser and better graded sand would have reduced the cost involved in placing the mortar and made subsequent repairs unnecessary.

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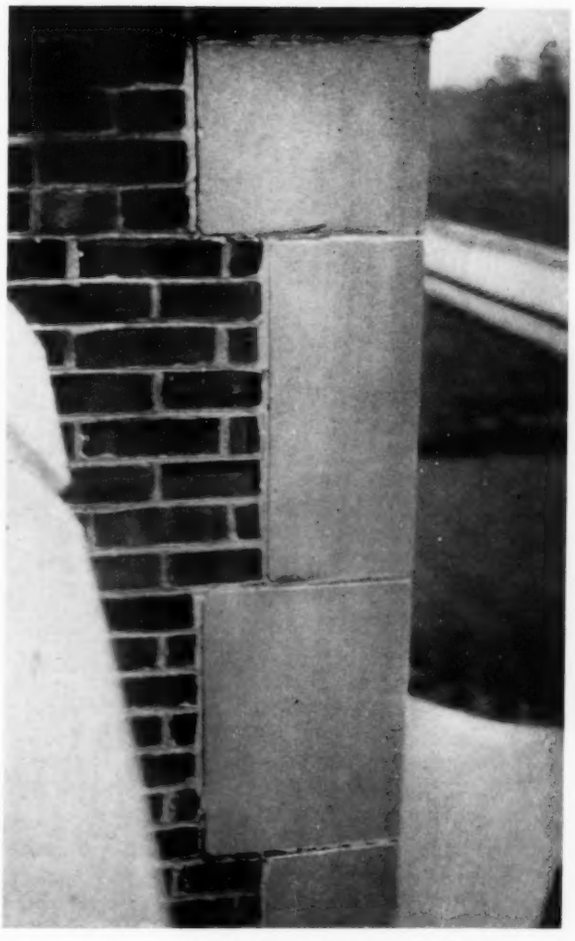
FLASHING

Although the value of proper flashing can hardly be over-estimated, there is undoubtedly a tendency to substitute flashing for good construction. It would even seem as though some engineers and architects believed that sufficient flashing would eliminate all leaks and act as insurance against poor workmanship. In this connection it is worthy of note that in our entire experience we have never found that the flashing was the sole cause of trouble on even a single building.

On parapet wall construction we recommend a through flashing above the roof level that will take care of the entrance of water from either side of the parapet, carrying the water out onto the roof or down the face of the wall. If there is a cornice at the roof level, we recommend that the flashing also extend over the entire top of the cornice, all flat surfaces being either covered with flashing or flashed under, as such may not shed water with sufficient rapidity to prevent infiltration. Surfaces subject to any appreciable volume of water accumulating on roofs or decks should be metal covered. A base flashing of sufficient height above the roof is of course necessary to take care of water that accumulates on the roof.

Flashing on the back of the parapet, commonly known as sheathing, should not be used. If it were necessary to cover the back of the parapet, it would be equally necessary to cover the front. If we assume that the masonry will leak, covering the back of the parapet cares for only one-half of the surface through which water may be expected to penetrate. Furthermore the practice is actually harmful as the flashing material interferes with the ventilation of the parapet wall, and should a falling temperature occur after a driving rain, bringing the wall to a freezing point, it is probable that an accumulation of supersaturated masonry will freeze on the side that is covered by the flashing, causing a crumbling and disintegration of the surface. We have seen parapets where the brick had been covered with black asphalt and after a short length of time there was a considerable amount of spalling and breaking away of the brick from the wall. This was due to the fact that imperfect ventilation prevented the



Courtesy of Common Brick Association of New York and New Jersey

Leaks due to unequal expansion of stone and brick. Joint between brick and stone should be raked out ½″ to 1″ deep and filled with an elastic caulking compound

General Building Contractor

Disintegration caused by membrane waterproofing inside parapet wall which prevented "wall breathing"

water from being driven out of the side which had been covered with asphalt and subsequent freezing caused disintegration of the masonry. This same condition also occurs under copper flashing, but it is not usually observed because the copper hides the masonry. It is recommended that the inside of parapet walls be left uncovered and that a through flashing be placed at the roof level. We have seen cases where the back of the parapet is not covered with copper and where the frost had caused the brick to crack and spall, but in these cases the bricks were underburned and were not of good quality. Good bricks do not spall.

On an open parapet where a capping of stone is used, it is well to flash through under the stone in addition to through flashing above the roof material. This through flashing under the stone takes care of the water which flat surfaces retain. We should also recommend copper flashing under sills that are made of brick or very porous cast-stone, but if the sills are of granite with no dividing joints throughout their entire length, flashing is not necessary. This practice applies to any stone with a small amount of absorption and where there are no joints.

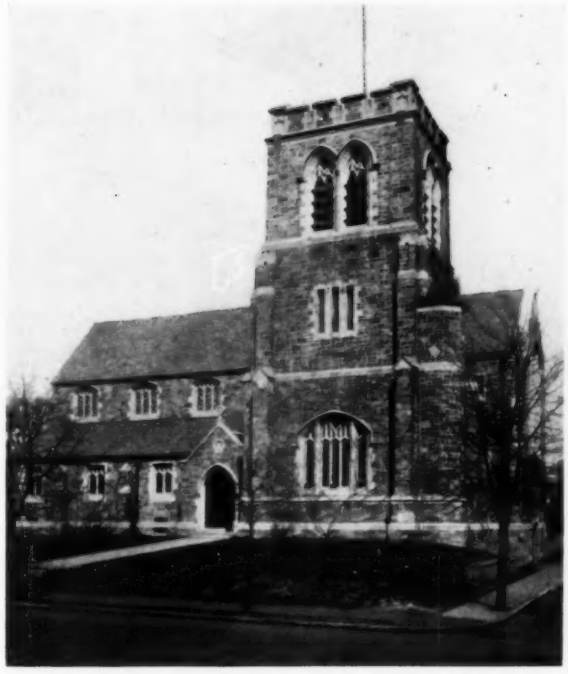
It should be realized that after through flashing is placed in a wall, the space immediately above the flashing is filled with masonry units and mortar, and it takes only a small amount of water to flood up to and overflow the turned up edges of the flashing. During a continuous, driving rain the water enters the wall through the many cracks and holes of the masonry joints above the flashing, and as these joints may number several thousand, it would be a physical impossibility for one bed joint above the flashing to carry off the water that is entering from the many joints above it. A driving rain has a wind pressure back of it which actually holds the wind against the side of the wall. A fifty-mile wind-driven rain develops a pressure equal to three inches of water.

Some persons believe that weepholes in addition to through flashing will solve the problem. These may help slightly, but the pressure of the wind during a driving rain may temporarily prevent the water from leaving the weepholes.

Let us consider two typical cases taken from our experience. Building No. 1 is situated on the Atlantic Ocean and built of fieldstone with two large chimneys extending well above the roof. The walls had leaked from the time the building was erected and three different attempts had been made to stop the leaks before our advice was requested. At the time we were called in the owner was considering a suggestion to take down the two chimneys to the roof level and flash through the masonry, carrying the flashing up several inches on the inside flue lining. This would have cost several thousand dollars besides an additional outlay for treatment of the main walls. The probable result would have been to eliminate leakage during a mild rainstorm up to the point where the copper would have overflowed. In a driving rainstorm of considerable length the water would have been concentrated at a single section, and after the saturation of the masonry had risen above the protective dam formed by the flashing, the owner would have discovered a leak he had never seen before. As a matter of fact, the chimneys were made raintight by attending to the joints and no additional flashing or hoods were necessary.

Building No. 2 is a church tower constructed of seam-faced granite. The top of the tower was de-

signed with a parapet, the back of which was covered with copper. The large and massive capstone was only partly flashed and the copper flashing was carried several inches under the stone on the roof side. This tower leaked from the time it was erected; the roofer was blamed for the trouble and payment withheld. He ran a number of tests by flooding the roof with water to a depth of several inches, but no leaks appeared. The next step was to take off the massive capstone as the owner felt that the leaks were due to water coming down through the stone. A copper flashing was then carried through under the stone; this should have been done when the building was erected. As the leaks still appeared after prolonged rains, the owner realized that the water came in through the exterior masonry. Many methods were suggested for stopping the leaks and over a period of five years three attempts were made to make these walls tight. With one attempt the owner received a guarantee, but the unfortunate part of a guarantee is that it does not offer a solution to any problem. After all of these worries and expenses the owner finally learned that the real cause of this trouble lay in the lack of a bond between the stone and mortar. Remedial treatment was confined to the joints which were cut out and repointed with the proper mortar to provide perfect adhesion to the stone units. The church is now as dry as could be desired.



General Building Contractor

St. Martin's Episcopal Church, Providence, R. I. Numerous experiments failed to make this building dry until the mortar joints were cleaned and repointed with the proper mortar

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CONDENSATION

If plaster is applied directly to exterior walls of solid masonry built without air space or other insulation, condensation is likely to cause a film of water to appear on the inside surfaces. In some cases this causes the paint to "burn," blister, or saponify. Sometimes it is difficult to determine whether the burning of the plaster is due to condensation or to the infiltration of water from the exterior of the building. If the condensation follows a period of driving rains, the burning of the plaster may be due to either or both causes. This can sometimes be determined by examining the condition of the plaster in the areas which show burning. If the plaster back of the paint is not thoroughly saturated with water, it is a case of condensation, but if the plaster is wet, it could be either condensation or leaking masonry.

The fact that condensation causes a burning of the plaster is due to the priming coat having been applied to too damp a plaster or to the use of an oil in the priming coat that is susceptible to the action of the free alkali in the plaster. It is also possible that even though the priming coat be properly applied and unaffected by the free alkali, the finish coat may be of such inferior grade that the water of condensation will penetrate and cause a deterioration of the priming coat as well as of the plaster, and the absorption of moisture by the lime will bring about a chemical reaction forming a bloom or whiskers of calcium salts on the surface. As this salt is often hydroscopic, it may attract moisture even when the paint film in other areas is not affected.

•

FURRING

The inside of exterior masonry walls should be furred, except in climates where such has proven unnecessary or in locations where there is sufficient protection from wind-driven rains.

Although there are many cases of raintight walls which have been plastered directly to the interior of the masonry surface, the chances are that a furred wall will not leak so readily as one that has no air space between the brickwork and the plaster. Furring may be of wood, hollow tile, or metal, depending upon the type of construction and the local building ordinance.

In order to obtain air space in the body of the masonry, some specify hollow brick walls in which the face and the back-up brick are separated by a two-inch space and bonded together and metal ties laid in the mortar joints at proper intervals. The Rolok type of hollow wall in which the bricks are laid on edge and an air space left through the center has also been successfully used on numerous

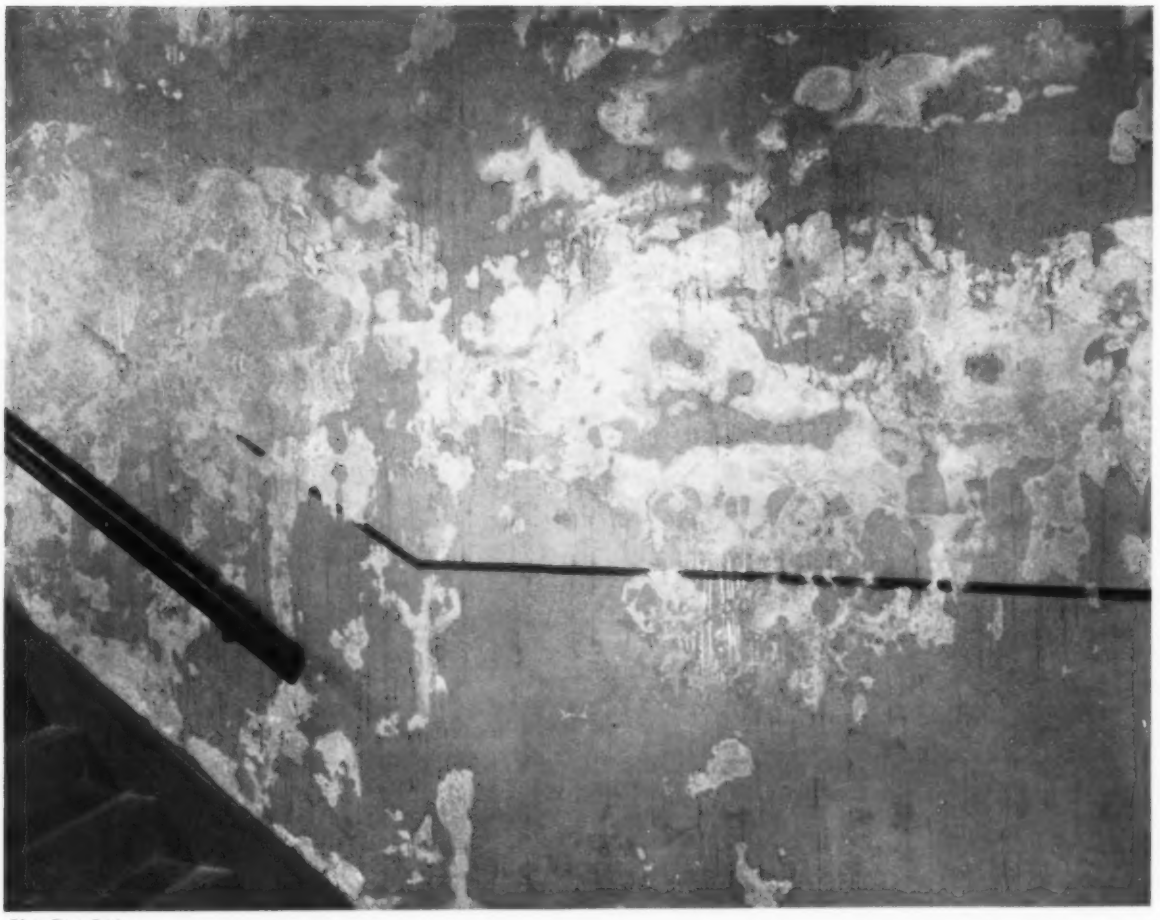


Photo. Dimit Brothers

Typical failure of plaster due to leaking wall, condensation or both. Better workmanship, membrane waterproofing and furring would help

operations. Many consider that walls of this type offer better insulation against cold and dampness, and they are used for the purpose of eliminating the furring, particularly for small residences. Experience however proves that the air space is apt to become filled with mortar and brick chips during construction, and that furring is a good insurance against condensation and leaks even when the wall is supposed to be hollow. When furring tile is used, care should be taken to avoid filling the space between the tile and brick with mortar as such would naturally lessen the insulating value of the construction. In many localities hollow tile back-up units have become the general practice for exterior masonry walls and give excellent results. An ordinary three-inch partition block also makes a satisfactory furring.

In locations subject to wind-driven rains, we should recommend that the inner surface of brick walls be damp-proofed before the furring tile is plastered. Damp-proofing however is of very little value unless the mortar joints have been properly pointed with a suitable mortar.

Although the Portland Cement Association has laid down a conservative policy in regard to furring walls built of hollow concrete units, it is regrettable that contractors take the chance of plastering directly on the inside of the block. As in the case of tile walls built of a single thickness of hollow tile, there are many cases where plastering directly has been successful, but this is not considered to be good practice.

A recent report submitted to the President of the Board of Education, New York City, contains the following statement: "It is of great importance that walls should be well built in the first place with good bricks and solid joints. A well-laid solid brick 12-inch wall damp-proofed inside, as an additional precaution against leakage, and then furred with hollow tile to prevent condensation, is most dependable."

ITEMS IN SPECIFICATIONS TO PREVENT LEAKS †

Bricks

This specification is applicable to common, solid or hollow (not face) clay brick of any of the following four classes:

V—Vitrified
H—Hard
M—Medium
S—Soft

Material and Workmanship. Brick under this specification shall be of clay or shale, be sound, of compact structure, reasonably uniform in shape, free from stones and pebbles that would affect their serviceability or strength, and without excessive laminations or warpings.

General Requirements. The standard size of brick shall be 2¼″ x 3¾″ x 8″, with permissible variations of ⅛″ in breadth or depth and ¼″ in length.

Bricks shall be delivered in good condition, with not more than 5 per cent broken.

At the completion of the absorption test the bricks shall show no evidence of disintegration.

Detail Requirements. The brick shall meet the following absorption and strength requirements for its respective class. The standing of any set of bricks shall be determined by the requirements in which it is lowest. Unless otherwise specified in the invitation for bids, medium (M) or hard (H) brick shall be accepted in lieu of soft (S) brick, and hard (H) brick in lieu of medium (M) brick.

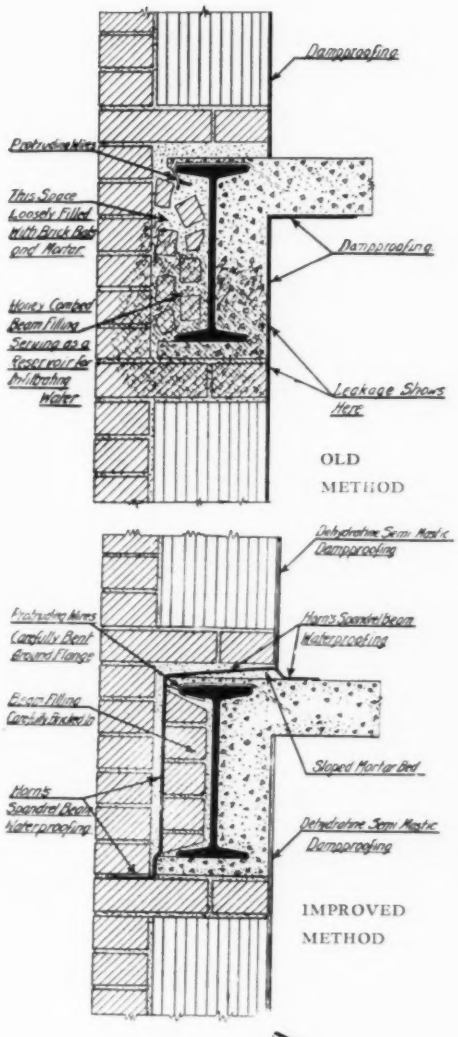
Brick should be of sufficient porosity to permit breathing or ventilation of the wall.

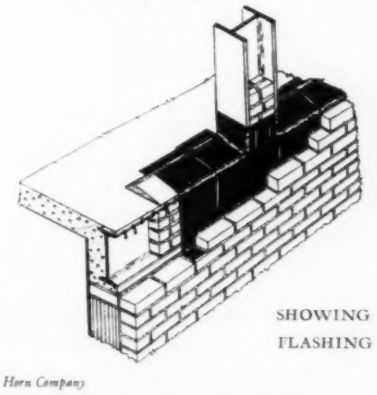
PHYSICAL REQUIREMENTS

Class	Absorption Per Cent*		Transverse breaking load, Pounds, 7-Inch Span	
	Average of Five	Individual Maximum	Average of Five or more	Individual Minimum
V	5 or less	6	2170	1450
H	5 to 12	15	1080	725
M	12 to 24	28	810	540
S	24 or more	no limit	540	360

* There appears to be a widespread belief that the percentage of absorption of individual bricks is a governing factor in the ability of brick masonry to resist moisture penetration. It has been conclusively shown that such belief is erroneous. If absorption percentage has any significance, it is as a possible measure of that quality of brick masonry known as durability.

† *Brick Engineering.* Vol. I, Pages 23, 24, 80, 81.





Courtesy of A. C. Horn Company

The area in front of spandrel beam, due to wall thinness, regardless of how well brick work is done, is a source of trouble difficult to prevent except with flashing. Furring and flashing at floor levels will not prevent leaks through structural cracks caused by movements of the structural frame but will generally prevent damage from water leaking in through these cracks

MORTAR

Portland cement and non-staining cement mortar shall be composed of 1 part cement, 1 part lime, to 6 parts of sand.

The proportion of lime should be increased for brick of high absorption and decreased for brick of low absorption. Also more lime should be used in summer than in winter.

Mortar shall contain ammonium stearate paste or . . . integral waterproofing in proportions as specified by the manufacturer.

LAYING BRICKS

Details of Brick Wall Construction. The face and common brick shall be shoved with full beds of mortar. No grouting nor buttering will be allowed, but all vertical as well as horizontal joints shall be thoroughly filled with mortar.

All brick forming the 4″ veneer shall be carefully laid 1″ clear of the outside diagonal sheathing, and care must be taken not to fill any part of this space with mortar. Every third stretcher in every fifth course shall be tied to the sheathing with galvanized Morse wall ties. Ventilate and drain the air space at the bottom by using 2″ drain tile. This drain shall be carefully formed and pitched to two outlets on each of the four sides of the house.

No part of the walls shall at any time be carried more than 4′-0″ above any other portion; they shall be stepped, or provided with approved anchors for connecting the sections.*

The mortar joints shall be of the weathered or concave type.

DAMPPROOFING INSIDE OF WALL

The following walls shall be entirely covered with..... applied in exact accordance with directions furnished by the manufacturers:

All exterior walls that have plastering applied directly on masonry.

All exterior walls that have brick facing. Paint shall be applied before facings are laid.

SPANDREL WATERPROOFING †

(*a*). *Bending Wires*

(This paragraph to be inserted in fireproofing specifications.) The fireproofing contractor shall bend all wires that extend past the outside of all spandrel beams so as to fit tightly against the underside of the beam flange. These wires shall be clipped so as to approximately reach the web of the beam when bent.

(*b*). *Spandrel Beam Filling and Mortar Bed on Top of Floor Arch*

(This paragraph to be inserted in the mason specifications.) The mason contractor shall fill in the space between the web and flanges on the outside of the spandrel beams and wall columns with brickwork so as to form a solid and smooth surface for the spandrel beam waterproofing.

On top of the floor arch and at its outside edge, this contractor shall also lay a bedding of cement mortar extending back at least 8″.

This mortar bed shall be sloped upward from the edge so that its thickness at the inside wall line shall be approximately and not less than 5/8 of an inch; this bed to form a base for the spandrel beam waterproofing to be applied later.

(*c*). *Waterproofing Spandrel Beams*

The outside of all exposed beams shall be waterproofed by the application of a membrane of.....

It shall extend through the entire wall and be carried in on the rough concrete floor at least 3″ beyond the wall line so as to lap on the wall dampproofing which will be applied later.

The membrane shall be carried down the face of the beam filling for depth and then out 3″ on first course of brick below bottom of beam.

All joints shall be lapped at least 3″ and well buttered.

The membrane shall be flashed up at least 6″ at the outside and two adjacent sides of all wall columns and on all faces of corner columns.

The membrane shall be applied in units approximately 3′ wide and of sufficient length to conform to the construction detail as specified above.

After the columns have been flashed as above described, the flashing around the corners shall receive a reinforcing strip of the waterproofing which shall be applied to the outside corners extending for the full height of the flashing and at least 3″ on each face of the column.

The membrane shall be pressed tightly against the underlying surface so there shall be no wrinkles.

This contractor shall co-operate with the mason contractor in order to properly schedule his work and avoid delays. All brick work, bending of wires, and application of mortar bed on top of the floor arch shall be done by others.

(*d*). *Dampproofing Solid Brick Walls*

The inside surfaces of all solid brick exterior walls, from ground floor level to pent house roof, shall be given a standard trowel coating of..... applied in strict accordance with the manufacturer's specifications.

(*e*). *Dampproofing of Hollow Back-up Tile*

The inside surfaces of all exterior walls having hollow tile backing from ground floor level to pent house roof shall be given one heavy, thoroughly covering coat of..... waterproofing.

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* Due to the manner of operating brick gangs skilled corner men frequently lay up brick ahead of the side men, with the result that the corner work is left toothed, making it difficult to properly mortar the adjoining brick work when laid. Many major leaks occur in such locations.

† Horn's Specifications for Waterproofing Spandrel Beams. A. C. Horn Company, Long Island City, N. Y.

THEATRE ACOUSTICS, VENTILATING AND LIGHTING

ACOUSTICS*

Obtaining good acoustics is not just a problem of putting sufficient sound absorptive material into a theatre. **It is entirely possible to get too much sound absorption or to place it in the wrong location.**

Acoustics is such a complex science that it is impossible to give an empirical method by which the architect may assure a theatre having good acoustics. However, a few general rules and cautions may be given.

SHAPE AND SIZE OF AUDITORIUM

1. SHAPE

Experience shows that theatres varying from a floor plan approximately square to a floor plan having a depth one and one-half times as great as the width give equally satisfactory results when other conditions are equally satisfactory. No definite limits may be set, although it is obvious that this ratio must not be extended too greatly.

2. SIZE

The ratio of height to width and length is largely a problem to be determined as a factor controlling the volume. **If original speech is a controlling factor in the acoustic design, the volume should be as small as other conditions permit, but not less than an amount such that the total absorption offered by the audience together with the absorption of the construction surfaces, carpets, drapes and other absorbing materials, will indicate a time of reverberation less than the selected optimum for an auditorium of this size.** (See graph page 91.) All volume added to the theatre over and above that just required to meet the above condition must be compensated for at a rate of approximately four units of absorption for each one hundred cubic feet of volume.

In the design of theatres for talking pictures, the limitation imposed by loudness is not nearly as severe, since within proper limits additional energy may be employed at the source, over that normally produced by a speaker. The employment of sound projectors having directional characteristics may further improve the relative distribution of sound in a large auditorium. However, the ability to increase the energy for the sake of obtaining added loudness carries with it the penalty of increased duration of sound due to reverberation; and the concentrated energy employed to improve distribution may give rise to acoustic difficulties in improperly designed auditoria that might be tolerated with normal energy input. Under certain conditions, however, theatres that would be defective for original speech may be made reasonably satisfactory for reproduced speech by proper employment of sound projectors.

3. CURVATURE

Curved walls or ceilings should be avoided.

A curved surface acts somewhat like a curved mirror back of a source of light. It produces convergent, parallel or divergent sound rays depending on relation of the source to the centre of curvature of the surface. This in itself is a sufficient source of acoustical difficulty and when it is considered that the auditorium is bounded on all sides by other surfaces either plane or curved, which may act as reflectors to the beam reflected from the first surface, it is possible to have a number of sound foci, resulting in echoes and points of interference scattered at various points throughout the auditorium. (See Fig. 1.)

The "atmospheric" theatre is an exaggerated case of faulty acoustic design from this standpoint. Cycloramas of any curvature, especially when made of hard plaster, are to be avoided at all costs. The plaster cyclorama should have a plane surface except that a curve of short radius at both ends and top may be permitted.

> Mr. Clifford Swan, consulting engineer on acoustics states:
>
> "Many architects still cling to the idea of vaulted or domed auditorium ceilings and curved rear walls, but *curved surfaces* are always a potential source of acoustical difficulty. It is sometimes possible to introduce such surfaces without injury to the acoustics but they should be considered only after a careful scientific analysis of the problem."

4. REVERBERATION

Wallace C. Sabine presented for the first time a practical method for forecasting, within limits, the acoustic condition of auditoria by stating a simple formula involving a mathematical relationship between the volume and the total amount of sound absorbing material present. This relation is such as to constitute a measure of the "Time of Reverberation," or the time required for a sound of certain

*By G. T. Stanton, Assistant Acoustical Engineer, Electrical Research Products, Inc.

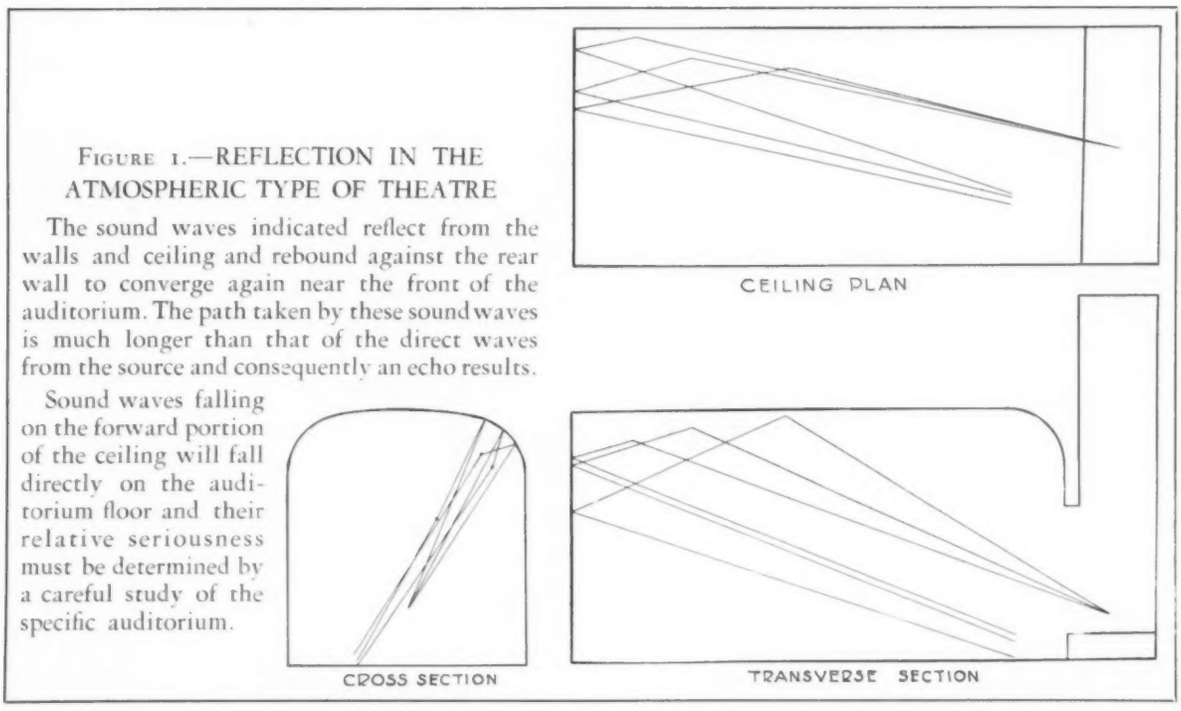

FIGURE 1.—REFLECTION IN THE ATMOSPHERIC TYPE OF THEATRE

The sound waves indicated reflect from the walls and ceiling and rebound against the rear wall to converge again near the front of the auditorium. The path taken by these sound waves is much longer than that of the direct waves from the source and consequently an echo results.

Sound waves falling on the forward portion of the ceiling will fall directly on the auditorium floor and their relative seriousness must be determined by a careful study of the specific auditorium.

specified magnitude to decrease in intensity until it can no longer be heard. The accuracy with which Professor Sabine's formula forecasts this factor reflects the painstaking nature of his work. However, the application of this factor presupposes certain conditions which may not obtain under the actual theatre conditions:

(a) The sound in question must persist for a period of time so that the intensity of sound is uniform throughout the auditorium.
(b) Sound must propagate equally in all directions.
(c) The material capable of sound absorption must be distributed with reasonable uniformity about the auditorium.
(d) The absorption must be in sufficiently small quantities to insure a moderately long time of reverberation. An improved formula has been offered in the past year by Dr. Carl F. Eyring which removes the latter limitation.

In addition it is essential to take into consideration the effects of changes in loudness, interference from extraneous sounds, echoes, and the effects of variations in the size of the audience.

RECENT DEVELOPMENTS

The modern approach to the science of acoustics is from the standpoint of what the ear must hear to be satisfied, and what must be done in the auditorium to obtain the conditions required.

The auditorium is considered to be a system for transmission of sound. The requirements of sound transmission in terms of auditorium acoustics are:

1. That a satisfactory loudness be maintained.
2. That there be no interfering noise introduced.
3. That the sound be unchanged or undistorted.

1. LOUDNESS

Loudness of speech is decreased as the size of the auditorium is increased, and as the amount of absorption is increased. These factors must be kept within limits that are determined by the loudness considered necessary in the most remote seats and are dependent upon the energy in the source of sound. The shape of the auditorium is also a factor since the energy reflected from the surfaces tends to increase the loudness in the auditorium.

2. NOISE

Interfering noise has two effects on hearing sound. One is the psychological factor of disturbance or annoyance which distracts the attention of the listener. The other is the physiological effect upon the ear which temporarily deafens more or less the auditor.

This latter effect is generally referred to as "masking," and in the presence of noise a greater degree of loudness of the original sound is required for equal articulation or ability to understand. The ability to understand begins to fall off as the loudness of the sound increases above a limiting level. **Noise therefore must be kept to such low levels as to not require an undue increase in loudness for good hearing.** In large auditoria the loudness, particularly for original speech, is generally the limiting factor in the permissible size of the auditorium, and any sacrifice in the effective loudness necessitated by

undue noise further restricts the permissible size of the auditorium.

PRINCIPAL SOURCES OF NOISE EXPERIENCED IN THEATRES

1. Mechanical equipment
   a. Ventilating equipment—blowers and driving motors, fans
   b. Booth equipment—projectors and driving motors—transverters and motor generator sets, noisy arcs
   c. Stage equipment—scene shifting
   d. Heating equipment—or combined auxiliaries with the ventilating equipment
2. Audience
   a. Walking in aisles and lobbies
   b. Conversation, coughing, etc.
   c. Restlessness while seated, seat noises
3. Noise created in other adjacent parts integral with the theatre building
   a. Elevators
   b. Dance Halls
   c. Bowling Alleys
   d. Industrial Plants
4. Exterior noise
   a. Street noises
      1. Through doors and windows
      2. Through structure
   b. Vibration noises
      1. Subways and Elevated RRs.
      2. Printing Presses
      3. General Industrial Plants

3. DISTORTION

The factors in an auditorium which cause distortion are:

a. Reflection of sound from surfaces at a time interval after the original sound too great for the ear to comprehend as one sound.
b. The absorption of energy at different frequencies or pitches in unequal amounts.

REFLECTION

Reflection of sound from walls and other bounding surfaces has two distinct effects. One is to increase the loudness of the sound throughout the auditorium and is helpful in articulation. The other effect of such reflections when they are delayed beyond a short interval of time is not to increase the loudness of a specific syllable or speech sound, but to act on the ear as an independent sound. If the individual reflection is intense and the interval sufficiently great an echo will result. Otherwise it will merely interfere with correct receptions of the desired sound.

The ear will accommodate itself to two similar sounds of equal loudness slightly displaced in time and hear them as one sound somewhat louder than either of the two parts. However, as the displacement in time between these sounds becomes greater, the increased articulation gained by greater loudness is more than offset by the loss in articulation due to confusion between the two sounds. Since the control of the relative intensity and consequent loudness and the time interval between the original sound and its successive reflections, are governed by the shape and acoustic absorption of the reflecting surfaces, the relationship of time of reverberation to acoustic quality may be seen.

UNEQUAL ABSORPTION

The ability of materials to absorb sound is dependent upon the frequency or musical pitch of the sound. In only a few specially constructed materials, generally not practicable for theatre use, is the sound absorption equal throughout the entire range of frequencies. It is obvious that if the total absorption in the room is greater at one portion of the frequency spectrum than at another, the composite sound heard by the ear (including the original sound and the energy reflected from the surfaces) will be relatively louder in that portion of the spectrum where the absorption is less. That is, if a material is used having high absorption in the range of the piccolos and low absorption in the range of the cellos, a duet by these instruments would sound unnatural, as the cellos would be louder relative to the piccolos than the artists intended. (See Fig. 4, page 92.)

The ear is not too critical of deviations, and considerable departure from an ideal condition is permissible. However, a very undesirable effect may be caused if the total absorption in the room is greatly different throughout the frequency spectrum. The condition of "dead" rooms is frequently due more to the fact that the high frequencies are more rapidly absorbed than others, rather than to the total quantity of absorption.

ARTICULATION

While some consideration should be given to the naturalness of speech, in general the principle requirement is that it be perfectly understood. The correctness with which speech is transmitted through any acoustic system, such as a telephone line, a radio system, or an auditorium, may be measured by determining the percentage of individual speech sounds that may be correctly understood when they are correctly produced. Such measurements represent the "per cent articulation factor" of the system; that is, if 80% of all speech sounds are correctly interpreted, the system has an articulation factor of 80%.

Such prediction may also be used in the future when a greater amount of empirical data is secured to establish limits of size and shape of theatres for each desired purpose. For the present, however, the employment of these factors directly in auditorium design is an intricate process, and a simpler method using time of reverberation and certain arbitrary rules is outlined, which should give a fair measure of

success in simple auditoria, and possibly be satisfactory in larger and more complex cases.

EFFECT OF VARIATIONS IN SIZE OF AUDIENCE

1. COMPUTATION

With the preliminary layout of the theatre completed, the number and type of chairs that are to be employed should be determined, the amount of aisle and other carpet estimated, and a computation made of the time of reverberation. This may be done using the Sabine or the Eyring formula. While the latter is somewhat more exact, the Sabine formula is simpler to use and should be satisfactory for present considerations if the desired time of reverberation is determined on a similar basis. For convenience, a graph (Figure 2) is included, on which is indicated various times of reverberation indicated as optimum for different houses by various authorities. These times of reverberation were either computed by the Sabine formula, or were measured under circumstances that approached the required conditions for accuracy of this formula. The range of values is rather large, being lowest where speech only is a consideration, and highest where music is to provide a major portion of the auditorium's use. From a comparison of the selected optimum time of reverberation and the computed time of the auditorium, the agreement between the two may be determined and the amount of additional acoustic absorption required may be determined.

Special consideration should be given to the acoustic characteristics of the chair selected. In auditoria where a variable audience is anticipated this becomes of primary importance in the quality of results obtained.

2. CHAIRS

The audience will comprise from 40 to 60 per cent of the acoustic absorption in the average theatre; and if its quantity is variable, the time of reverberation will fluctuate with changes in the number of audience. The only practicable method at the present time of overcoming this variability is to employ chairs, the seat and back of which offer a relatively high coefficient of absorption. Chairs are available that when empty offer absorption fifty to seventy-five per cent of that when occupied. The merit of employing such chairs is obvious from the attached graph (Figure 3), which indicates time of reverberation for different audience conditions of two typical auditoria having the same volume and seating capacity, and approximately the same time of reverberation at two-thirds audience, one employing high quality chairs, the other employing extremely poor chairs of the ordinary ply-wood type. The time of reverberation of the theatre employing wooden chairs is also shown, assuming that sufficient fixed absorption were added to reach limiting acceptable values for all audiences. The auditorium is then too dead for the normal conditions of more complete attendance and while acceptable, too reverberant for less than one-half audience. The use of the highly absorptive seat gives times of reverberation within plus or minus ten per cent of optimum for the majority of the conditions of attendance, and well within acceptable even when empty. For convenience, there is included in Table 1 the absorptive values of various standard types of theatre chairs when empty.

3. ACCEPTABLE CONDITION

Attention is directed to the use of an acceptable in addition to an optimum value. **A theatre should be designed so that its time of reverberation, in addition to being optimum at the largest average audience (which, lacking other information, may be generally assumed as two-thirds of the total), must be within at least acceptable limits for the smallest anticipated audience.** The type of theatre has much to do with the anticipated small audience. In motion picture houses other than the so-called "presentation" house, the first matinee performance may run as small as 15%. In the chart, Figure 2, there is indicated the limit of acceptable time for talking picture houses. This is a special case and is applicable as the poorest condition that may be considered commercially acceptable; and further applies only for sound reproduced by means of directional projectors. To specify definite limits of acceptability for each of the different classes of use of an auditorium is scarcely feasible, due to variations in the standards and requirements of the different houses. The tolerance or deviation from the optimum condition should be less for original production of speech than is indicated for reproduced speech and music. This must be given special consideration and in general, should be as near the optimum time selected as practicable.

REDUCTION OF EXCESSIVE REVERBERATION

If the time of reverberation, computed as above, is excessive compared with desirable values, there are two methods of attack:

1. REDUCTION OF VOLUME

This is particularly desirable where the loudness obtained from original speech is the controlling factor.

2. ADDED SOUND ABSORPTION

Materials having high values of sound absorption may be added to wall or ceiling surfaces, in amounts sufficient to adjust the time of reverberation to satisfactory values.

ABSORPTION COEFFICIENTS OF THEATRE CHAIRS

BACK \ SEAT		Plain wood seat	Panel of padded upholstery attached to wood seat		Upholstery and padding applied over springs	
			Leather	Velour	Leather	Velour
Plain wood back		0.2	0.7		1.1	
Panel of padded upholstery attached to wooden back	Leather	0.7	1.2		1.6	
	Velour			1.9	2.0	2.3
Fully upholstered padded back. No springs	Leather	1.1	1.6		2.0	2.3
	Velour				2.5	2.8
Upholstery and thick padding applied over springs	Leather				2.3	
	Velour				3.2	3.5

Adopted from data furnished by American Seating Company.

NOTE: * The absorption of mohair upholstery may be assumed to be the same as that of velour. Imitation leather is considered the same as leather.

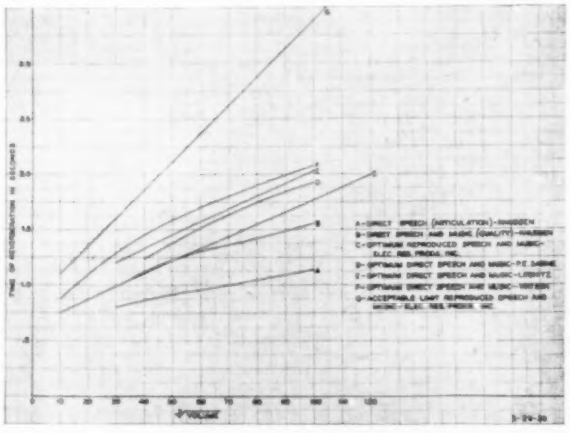

FIGURE 2

OPTIMUM AND ACCEPTABLE TIMES OF REVERBERATION

The above curves indicate suggested optimum times of reverberation, and an acceptable limit for a special case discussed in the text, of auditoria for different purposes. The times are plotted with respect to the cube root of the volume. The curves C and G are furnished by Electrical Research Products, Inc. The other curves are taken from various writings and publications of the indicated authors.

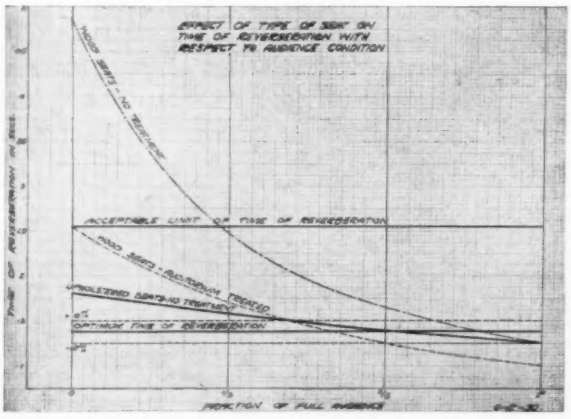
EFFECT OF TYPE OF SEAT ON TIME OF REVERBERATION WITH RESPECT TO AUDIENCE CONDITION
ACCEPTABLE LIMIT OF TIME OF REVERBERATION
OPTIMUM TIME OF REVERBERATION

FIGURE 3

TIME OF REVERBERATION FOR DIFFERENT NUMBERS OF AUDIENCE

The curves indicate the times of reverberation for different audience conditions in a typical auditorium, having a volume of approximately 200,000 cubic feet. For the curve labelled "No Treatment" it was assumed that no specific acoustic treatment was added to the theatre.

TYPES OF MATERIALS

The materials available for introducing added sound absorption may be roughly divided into six classes:

1. DRAPERIES

Draperies for this purpose should be of a heavy, soft body, such as velour; and to secure the best efficiency of absorption should be loosely draped, in general utilizing at least thirty per cent additional material to cover the surface. Their employment in too large quantities is generally undesirable from an aesthetic standpoint, and the absorption is largely in the higher frequency range. Draperies may be flameproofed where required, although their absorption is, in general, slightly reduced by this process.

2. ACOUSTIC PLASTERS

Acoustic plaster is frequently applicable in new construction, as it may be used in lieu of the normal finish coat of plaster. The absorption coefficient of such plasters is relatively low, but since large areas are generally available for treatment, such as entire ceilings, they are frequently adapted. For surfaces where echo or concentration effects are anticipated, plasters are not generally suitable, since a material of high absorption is required. Since the efficiency of acoustic plasters is dependent upon the skill and care with which they are erected and surfaced, careful supervision of this work by a competent engineer must be arranged to insure that the erection is in accordance with methods known to produce the desired amount of absorption. Such plasters are of course "fireproof" within all building code requirements.

3. ACOUSTIC TILES

Acoustic tiles of various forms are available, many predecorated and others suitable for decoration after erection. For some types of interior treatment the tiles are a very helpful medium, since relatively high coefficients may be obtained and pleasing architectural effects produced. The acoustic tiles are available in various degrees of fire resistance.

4. FELTS

Hair felt is the oldest form of acoustic material. It is available today, as well as various modifications, including mixtures with asbestos fibre felts composed of jute and of wood fibre. In general, the felts must be employed in plaques or panels behind thin or porous draperies. The felt containing asbestos fibre is employed together with a thin membrane by one of the commercial companies to simulate ordinary plaster by painting the membrane after the felt is erected. Felts are inherently not fire-resisting. They are available in various degrees of fire resistance, from highly inflammable to reasonably resistive. Further objection is found to many forms of felt in that they offer breeding places for vermin and may produce undesirable odors in damp locations. Some felts are processed to remove these objections.

5. BOARDS

A number of common building boards have some absorptive value. They are generally inefficient, but have desirably uniform characteristics of absorption with respect to frequency. Their employment is not generally recommended due to difficulties in decoration, as they must be left unpainted or treated with special stains. The boards available for acoustic use are all inflammable. Any existing methods of fire-proofing destroy their acoustic properties.

6. SPECIAL

Newly developed materials are being added to the list continually. There is available a product consisting of ground paper and asbestos particles which may be sprayed on to the surfaces, where it is held with an emulsified asphalt. This material offers interesting possibilities and is reasonably fire-resisting, but is extremely fragile. The employment of porous cinder blocks, leaving the interior surface unpainted or sprayed with special acoustic paints, offers possibilities for development. Various contractors utilize special systems and combinations of systems to gain the desired results.

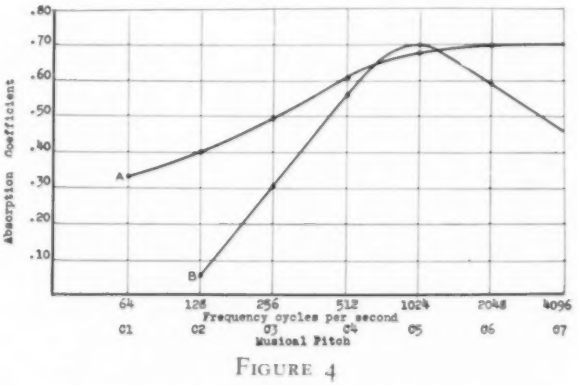

FIGURE 4

COMPARISON OF THE ABSORPTION FREQUENCY CHARACTERISTICS OF TWO COMMERCIAL SOUND ABSORBING MATERIALS

Curve A represents a material having characteristics considered excellent. Curve B indicates a material which, while highly efficient at 512 cycles (the frequency most commonly employed in computations), has an absorption frequency characteristic considered poor. (It may be noted that the absorption at 1024 cycles is over ten times that at 128 cycles.) This latter frequency is about that produced as the basic pitch of a male voice.

SELECTION OF MATERIALS

In the selection of a proper material consideration must first be given to the locations which require treatment and other surfaces that are available. The surfaces upon which concentrated energy from sound projectors may be incident should be treated with an efficient material. Consideration should then be given to the necessary coefficient for the remainder of the material necessary to obtain the required amount of absorption. The decorative requirements should then be considered, selecting a material which meets the above requirements. The absorption frequency characteristics should then be compared and primary consideration given to that material having the most nearly uniform characteristic.

HEATING, COOLING, AND VENTILATING THE THEATRE*

Increasing demand for physical and psychological comfort has made the heating and ventilating of the modern theatre a problem of complete air-conditioning.

Data collected by the American Blower Corporation show that in an uncooled theatre the average weekly attendance is 64,905 for all months with the exception of June, July and August. In June, July and August the average weekly attendance is 51,582, a drop of 13,323 paid attendance per week during the three hot months. In a cool theatre the average weekly attendance for all months with the exception of June, July, and August, is 58,373, while during June, July, and August, the weekly attendance is 59,300.

A satisfactory system of air-conditioning must automatically control air volume, air temperature, relative humidity, air motion, and air purity. The requirements of the legitimate theatre and the movie theatre present two distinctly different problems. The legitimate theatre is seasonal, occupied about three hours at a time, usually after sundown, and closed during the hot summer months. The movie theatre is occupied, often to full capacity, for twelve hours per day every day in the week and all year round. The air-conditioning plant must be able to meet the requirements of the two extremes of outside weather conditions. The volume of air to be handled in the movie theatre is therefore often more than twice the volume required for the legitimate theatre.

A. AUDITORIUM

The warming of the auditorium is really a deheating problem. The heat radiated from the occupants of the seats and from the lights usually exceeds the heat loss through the walls and the roof of the building even in the winter time. The removal of the excess heat and moisture can only be accomplished through a complete ventilating system; and the fresh air must be admitted at a temperature lower than that of the room to effect the necessary cooling. (A typical case for winter conditions might show 300 B.t.u. of body heat, plus 100 B.t.u. per person from lights, etc., being given up to the building, against 200 B.t.u. heat loss from the building, per person per hour. This would mean that 200 B.t.u. per person per hour must be carried away by the ventilation.) The quantity of air to be supplied and removed by the ventilating system is determined by the number of persons to be seated in the theatre. Desirable standards vary from 25 to 30 cubic feet of air per occupant per minute.

1. SYSTEMS OF DISTRIBUTION

It is important that the conditioned air introduced in the auditorium be distributed evenly with respect to the amount of heat to be absorbed in the various parts of the room. Three methods of distribution can be used.

a. Ejector System. The conditioned air is introduced through a series of ejector nozzles near the ceiling and the underside of the balconies in the back of the auditorium, discharging horizontally at high velocity. Losing speed, the air moves down and is removed through exhaust grilles located near the floor at the back of the auditorium. **This system is the cheapest in initial cost and insures an effective mixture of the air in the auditorium. It cannot, however, be used where the ceiling and the underside of the balconies are beamed or have protruding forms that would interfere with the air current.** The advantages of the downward air movement will be discussed below.

b. The Upward System. The air is introduced through mushroom hoods in the floor and exhausted through the ceiling, utilizing the natural upward rise of the air after it has absorbed the heat radiated from the seated persons. **This system is not generally used. The air has to be introduced at a low velocity in order to avoid draught; and the two features that cool air strikes the feet and that the body odors and dust are carried up with the air are objectionable. The use of mushroom hoods furthermore necessitates an expensive system of air-tight chambers under the floor.**

c. The Downward System. The conditioned air is projected horizontally into the auditorium near the ceiling or through diffusers in the ceiling against a horizontal baffleplate and spread evenly over the whole upper area of the auditorium, mingling uniformly with the air in the room. Moving down, the air absorbs outer heat transmitted through the walls and the roof and the heat emitted by the occupants of the seats, and finally reaches the desired temperature and humidity before it strikes the seated persons. The air is then removed through exhaust

* By K. Lönberg-Holm.

outlets near the floor. The moving force of the inlet fans makes the upward effect of the heat from the people negligible.

B. LOBBY

The lobby and foyer can usually be included in the general air-conditioning system. Additional banks of direct radiation in recesses near the doors, or a special fan system discharging through grilles at each side of the doors, should be installed to insure quick heating and to prevent cold air from being blown into the auditorium. If there are two sets of doors in the lobby both sets of doors should be equipped this way.

C. STAGE

Sufficient radiation should be installed to prevent air currents in the front part of the auditorium from interfering with the air-conditioning system. The radiation should be evenly distributed and special provision should be made for exterior doors leading to the stage. The wall radiation is usually placed at two or three levels on the exposed walls, and additional heating coils provided in the skylight, and immediately above the proscenium opening.

D. PROJECTION ROOM

The projection room can be included in the general air-conditioning system but should have a separate exhaust system for the projection machines, to protect the film from contact with dirt-laden air.

E. DRESSING ROOMS, TOILETS, REST ROOMS

These rooms can be included in the general system. If necessary, additional direct radiation is installed on exposed walls. The toilets should be equipped with separate exhausts.

F. RECIRCULATION

A saving of up to 50% in fuel consumption can be effected through recirculation of a portion of the air used for the air-conditioning system during the winter. The recirculated air should be cleaned before it enters the distribution ducts.

G. COST DATA

Approximately 75 to 100 tons of refrigeration are required per thousand people.

A complete ventilating plant with refrigeration will cost from $200 to $800 per ton of refrigeration.

Initial expenditures are approximately $35 per seat. This includes a complete conditioning system with refrigeration machine. Cost of operation per day per seat throughout the year averages between 3 and 3½ cents. This includes depreciation, engineer's salary, power, steam, water, interest on investment, and all incidentals. Naturally the cost of operation during the winter is much less than in the summer.

Assuming that each seat is occupied at least twice a day, the cost per ticket is slightly over 1½ cents. The system replaces the ordinary heating, air-washing, and fan system that might be installed.

Estimating the maintenance of this system at 2 cents per day per seat, brings the additional cost of the complete air-conditioning system down to 1 cent, or ½ cent per expected patron. The difference per day per 1,000 seats is approximately $15. A daily sale of 43 additional tickets at the low average of 35 cents absorbs this excess.

LIGHTING FOR MOTION PICTURE THEATRES

The following suggestions are from an article on "Theatre Lighting"* by Frank Cambria** and Francis M. Falge.***

There should be a well-planned, single-circuit system of illumination for lobbies, foyers, rest rooms, etc., which should be graduated in intensity from street to auditorium.

Lobbies should be bright and cheerful.

Many small bright sources of light are pleasing for lobbies.

Foyers should be of lower intensity with soft colored lights.

Rest rooms should be colorfully and comfortably lighted.

There should be a specially planned and controlled system of auditorium lighting, making possible the advantages of mobile color and of a variety of effects. There must also be a comfortable, glareless system for the showing of pictures.

There should be no bright light sources near the line of the vision of the picture.

Stray light should be eliminated from the picture sheet as much as possible.

Sufficient light should be provided so people may easily locate seats, and so that accidents may be eliminated.

Sufficient light should be provided to discourage undue familiarity, but not so much that patrons are distracted by the movements of others.

Aisle lights and side-wall brackets should be on separate circuits, controlled from the stage switchboard.

Cove circuits should be carefully planned for many variations of quantity and quality of light. They should be on dimmers.

There should be a carefully devised emergency lighting system, separate and distinct from the other lighting arrangements, connected with storage batteries as per building code.

* A paper presented before the Twenty-third Convention of the Illuminating Engineering Society, Phila. Sept. 1929. November issue of *Transactions of the Illuminating Engineering Society*, 29 West 39th Street, New York City.

** Director of Art and Stagecraft, Publix Theatres Corp.

*** Lighting Specialist, Publix Theatres Corp.

Local, state, and federal codes must be strictly adhered to.

There should be a separate lighting system for cleaning, preferably a permanent one, but at least including portable lights and conveniently located outlets.

It is preferable to have concealed units of high intensity which are operated by a switch.

This should include supplementary lighting for passageways and other places which might be included with other circuits not needed for cleaning.

It is highly desirable to arrange the lighting of the motion picture theatre so that the eyes of the patron entering the theatre are not subjected to any sudden and great change in the illumination. If the change from the exterior to the interior levels of brightness can be made gradually and extended over an appreciable period, the adaptation processes have time to operate, and the person entering will be able to see comfortably at the illumination level existing within the auditorium. From the measurements of illumination and brightness, it is possible to trace the decrease in brightness level as the patron passes through the various entrance areas. In the accompanying table are tabulated some of these values in a way calculated to illustrate this brightness decrease in the case of a person entering the theatre through the main lobby, orchestra foyer, and on into the central portion of the main floor.

IN MAIN LOBBY:		
Just Inside Entrance	(Thirty-inch plane)	15.0 f.c.
Centre of Lobby	(Thirty-inch plane)	2.0 f.c.
Near Orchestra Foyer	(Thirty-inch plane)	1.0 f.c.
Mean Wall Brightness in Lobby		2.0 ml.
MAIN VESTIBULE:		
Just Inside Door	(Thirty-inch plane)	.23 f.c.
Under Main Lamps		.16 f.c.
Mean Wall Brightness		1.6 ml.
ORCHESTRA FOYER:		
Just Inside Door	(Thirty-inch plane)	2.0 f.c.
Directly Under Lamps		.53 f.c.
Near Entrance to Aisle		.09 f.c.
Mean Illumination	(Thirty-inch plane)	.20 f.c.
Mean Brightness of Vertical Surface in Field of View		.25 ml.
CENTRAL PORTION OF MAIN FLOOR, Seat Q-107:		
Illumination on Thirty-inch Plane		.04 f.c.
Illumination on Program at 45 degrees		.06 f.c.

The experience gained from numerous installations indicates that where an auditorium is decorated in silver-leaf and light colors, 10 watts of lighting in each color should be provided for each seat. Where gold-leaf and warm or heavy color decorations are adopted, 20 watts in each color should be provided for each seat to afford "reading" illumination. In urban motion picture theatres, where "reading" light is not required, satisfactory lighting has been effected with as little as 4 watts, each color, per seat.

A. LIGHTING THE ATMOSPHERIC THEATRE *

The illumination of the atmospheric theatre is by far the most important single factor, for the lighting results will in most cases determine the success or failure of the entire project. In a true atmospheric theatre, the auditorium is in reality a permanent stage setting of large dimensions. The aim of the architect is to create an exterior scene taken from some distant land, such as a Spanish courtyard, in which the patrons are seated. The illusion of the open sky is created almost entirely by artificial lighting from concealed equipment. In addition, the general architectural theme must be revealed while the house is in comparative darkness. Here again skillfully located lighting equipment is of the utmost importance.

The evening sky effect, which includes twinkling stars in a field of deep blue across which drift fleecy clouds, is the major theme of the lighting scheme.

For the blue of the sky, continuous reflectors are installed in a cornice or equivalent structure at the imaginary horizon. The ceiling is shaped to approximate, as closely as conditions will permit, a hemispherical canopy. At the point of intersection of the "horizon" it is kept as far back as possible to suggest indefinite origin. An impression of greater depth is secured by giving the ceiling the texture of a "scoured" finish. Great care must be exercised to keep the ceiling surface absolutely even, for this type of illumination greatly accentuates any unevenness. The ceiling should be tinted a *flat pale blue*.

The so-called "natural" blue glass lamps should be used, spaced 12 inches apart around the four walls of the auditorium in a continuous type reflector. Even illumination without "spotting" is highly essential. In addition to blue lamps, amber and red are often used to create special effects such as a sunset during the overture or similar features.

Illuminated stars are secured by placing low candle-power lamps in cone reflectors back of perforations from 1/8 to 1/4-inch in diameter in the ceiling. These lamps are connected to flashing devices to cause a few stars to flash at a time. With the proper ceiling with deep blue illumination, these stars are startlingly realistic. The perforations are laid out to scale to represent the respective positions of the stars in the firmament. The Great Dipper comes in for its usual share of attention.

"Effect machines" of the rotating disk type, concealed in the side walls, project slowly moving clouds across the ceiling. With a well designed ceiling, these clouds actually appear to be at a considerably lower level than the ceiling, which greatly adds to their effectiveness.

Auxiliary lighting equipment concealed in the structural work serves to reveal the dominant architectural features such as arches, columns, and niches.

---

* A. L. McCABE, Chief Engineer, *Erickson Electric Co.*

This part of the lighting design is of great importance due to the fact that the general illumination of the entire auditorium is necessarily kept at a low level during a major part of the show. Concealed lighting for the organ grille and wall niches from colored lamps in strip reflectors is particularly effective.

A variety of color should be used in the various locations to add interest to the general effect. Amber lamps in shielded wall bracket fixtures, together with a generous use of aisle lights, provide the necessary "working" illumination.

Wall brackets, aisle lights, steplights, and exit lights, are connected to an emergency storage battery system by an automatic throw-over switch in case the building current should fail.

Flush ceiling fixtures or lunettes are provided under balconies and in similar locations where the height prohibits the use of indirect lighting. Through the use of colored light, the general effect can be preserved.

Dimmers are provided on each group of circuits to afford a smooth blending of the various colors as well as to change the level of intensity. All stages of illumination, from mysterious moonlight to the effect of sunshine, may be produced at will.

B. WALL AND CEILING WITH COLOR LIGHTING

The latent possibilities of projected beams of light as compared with pigments for purposes of producing decorative effects have not yet been fully explored.

The walls of the auditorium of the legitimate or movie theatre can be painted a plain white or cream and all decorations may be obtained by shadow or mobile color lighting.

It should be borne in mind that, while the means for obtaining effects are simple and the colors are thrown on a plain background, the effects which can be obtained, both of form and color, are almost limitless.

THE CHARACTERISTICS OF COLOR LIGHTING

From the standpoint of the physicist the image one gets when looking at a painting is composed of the light rays (from sun or artificial light) *less* the light rays absorbed by the pigments used in the painting.

Color effects may be obtained without the use of pigments by, first, absorbing the light rays not desired by a color screen near the observer (stained glass windows), or a color screen near the source of light (stereopticon or movie); second, refracting light into spectral colors with prisms; third, producing color effects through the use of various mediums for producing light (vapor lighting systems, etc.). The stained glass windows, stereopticon, color movie, crystal prisms, diamonds, or even rain drops (rainbows), produce emotional reactions difficult to duplicate with paint.

COLOR LIGHTING ESPECIALLY SUITABLE FOR USE IN THEATRE AUDITORIUM*

Due to the ability to vary the effects to coincide with the type of play and the varying moods of the play, the use of color lighting for decoration of walls and ceilings is especially suitable for theatres.

In decorating the auditorium care is to be taken that during the performance nothing conflicts with the main interest, which is on the screen. It is during intermissions that decorative lighting of the auditorium should be featured.

There are two large groups into which decorative lighting is divided: shadow lighting and mobile lighting. The first makes use of geometrical and conventionalized patterns which may be varied by dimming and changing colors. The second is more abstract, more flexible, and is characterized by a continuous sense of motion and depth.

Shadow Lighting

Color shadow lighting projects beautiful harmonizing forms on either ceiling or sidewall, or both.

Color shadows can be projected either from coves, fixtures or pedestals. The source and placing of the units can best be determined from actual experiment.

As a rule, reflectors are undesirable, as the best color shadows are projected from the clear bulb—a point source of light being the ideal source. In most cases, reflectors tend to fuzz the edges of the shadows and to detract from the design, although in some cases reflectors are of material assistance in securing the effect desired. The recommendations in each case must be the result of experiment; there is no rule of thumb that is reliable.

A cove can be so designed that the lamps which produce the color shadow effects also illuminate the room, or the color shadow lamps can be supplementary to the standard cove lighting layout.

With fixtures, a definite pattern can be projected on the ceiling in white light leaving black shadows. Color lighting from standard interior equipment then lights the shadows in solid or blended colors as required. Another type, experimental samples of which have been very successful, is to have only the standard interior color equipment in the fixture and then have an intercepting screen of open work design suspended from the ceiling in the form of a drum. This design is projected in long shadows of various colors which change color and shape as the various sources are dimmed and brightened.

The most effective colors are red, blue, and green. These can be mixed in the proper proportions to produce a white field and then broken up by the intercepting screen. This introduces an element of mystery which always appeals to the lay mind. Amber does not seem to produce effective color shadows and interferes with the other colors. For this reason, it is not recommended.

* *Memorandum*, Curtis Lighting Co., Inc., Chicago.

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The Story of Delano & Aldrich

DELANO & ALDRICH occupy a conspicuous position in the forefront of the architectural profession. Of international renown, buildings of many kinds designed by this firm are to be found from California to the battlefield of Waterloo.

The American Embassy building, about to be erected on the Place de la Concorde, in Paris, is being designed by this firm, as is the Embassy for the Imperial Japanese Government, at Washington. The American Pavilion at the International Art Exposition in Venice, a residence on the famous Belgian battleground and Dartington School, at Totnes, South Devonshire, England, are among the noteworthy foreign commissions executed by Delano & Aldrich.

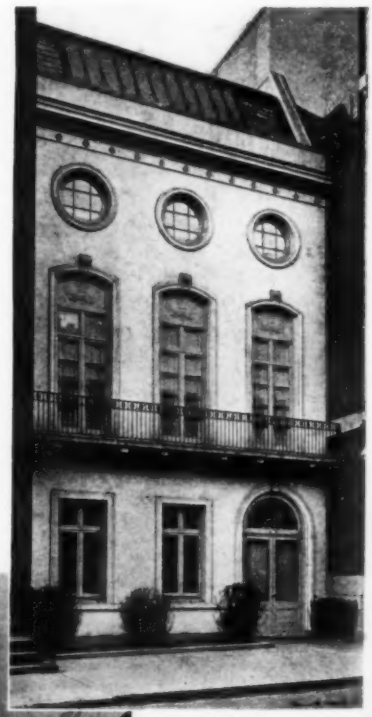
Their work in this country includes the Walters Art Gallery, Baltimore, Williard Straight Hall at Cornell, Sterling Chemical Laboratory, the Sage Forestry School and several other buildings at Yale, Music School for Smith College, Northampton, Pocantico Hills residence of Mr. John D. Rockefeller, Sr., Port Washington residence of Mr. Vincent Astor, Cold Spring Harbor residence of Mr. Otto H. Kahn; bank and office building at Wall and Hanover Streets, apartment houses at 925 and 1040 Park Avenue and the Third Church of Christ, Scientist, all in New York City, the Herter residence in Santa Barbara, California, and the United States General Post Office Building, in Washington, the construction of which will start shortly.

Occupying some 15,000 square feet of floor space and employing about 70 persons, this firm does annually between eight and ten million dollars worth of work. The present year is the best in the history of the organization.

Both Mr. Delano and Mr. Aldrich are Fellows of the American Institute of Architects and Diplomés of the Ecole des Beaux Arts, in Paris.

William Adams Delano, a graduate of Yale, was an appointee of the late President Wilson at the Versailles Conference, he was also appointed by former President Coolidge, to the National Fine Arts Commission. He is a member of Secretary Mellon's Board of Architectural Consultants and of the National Capital Park and Planning Commission. He is also President of the New York Chapter of the American Institute and Chairman of the Institute Committee on Public Works.

Chester H. Aldrich, a graduate of Columbia, recently received a doctor's degree from that University. He was decorated by the Italian King following his services as Director General of Civilian Affairs, American Red Cross Commission to Italy. He has served on many juries of the Le-Brun Traveling Scholarship, the First Avenue Association, the Prix de Rome and the Beaux Arts Institute of Design.



Delano & Aldrich offices are located in a building, in the Murray Hill district of New York City, that was once a stable

Corner of Library in Delano and Aldrich offices. Many rare volumes on architecture are in this collection. Walls are paneled with fine old Italian oil paintings

Entrance hall with reception rooms and library on the left; stair to executive offices at rear